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PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XX.

THE NEMERTEANS.

BY WESLEY R. COE, PH.D.

YALE UNIVERSITY.

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THE Harriman Alaska Expedition, during the months of June and July, 1899, afforded exceptional advantages for the investigation and collection of the marine invertebrate fauna of the Alaska coast south of Bering Sea.

During the course of the expedition collections of Nemer-teans were made at Victoria (Vancouver Island) and Lowe In-let in British Columbia; at New Metlakahtla (Annette Island), Cape Fox, Wrangell, Farragut Bay, Taku Harbor, Juneau, Skagway, Glacier Bay, Sitka, and Hot Springs on the islands and mainland of southeastern Alaska; at Russell Fiord and Yakutat Bay; at Orca and Virgin Bay in Prince William Sound; at Kadiak; at Popof Island, Shumagin group; at Kukak Bay on the Alaska Peninsula; and at Dutch Harbor, Unalaska.

Stops were made also on St. Paul, St. Matthew, and Hall Islands in Bering Sea; at Plover Bay, Siberia, and at Port Clarence, Alaska, just south of Bering Strait. At these latter localities, however, the shores are surrounded in winter by pack ice, which prevents the existence of any considerable amount of life between tides. No Nemerteans were found here between tides in the limited time at our command, though it is not unlikely that in deeper water an abundance of these worms could have been obtained by the dredge. South of Bering Sea, on the other hand, the shores are densely covered nearly to high water mark with a luxuriant growth of nearly all classes of invertebrates.

All along that part of the coast which borders the North Pacific Ocean—from Dixon Entrance to the Aleutian Islands—with the exception of areas subject to local disturbing elements, such as the proximity of rivers and glaciers, invertebrates occur in remarkable abundance. Not only is there an enormous number of individuals, but also a great variety of species. And, furthermore, the unusually large size which many of the species attain is quite as striking as the wealth of species and individuals. The purity of the water, its freedom from contamination from muddy streams, and the great rise and fall of the tides with their consequent swift currents, which continuously provide a rapidly changing supply of pure water, furnish conditions especially favorable to the growth of marine invertebrate animals.

Exceptions to these favorable conditions were found at Juneau, where the water is of slightly less than normal density, and contains a considerable amount of sediment. At Skagway these unfavorable conditions are still more pronounced, and here very few Nemerteans could be found between tides. In Russell Fiord the water was decidedly brackish, there was little tide, and almost no shore collecting could be done. Localities in the vicinity of glacier fronts were extremely barren of marine life, as was to be expected.

Perhaps the locality which proved the most fruitful was Dutch Harbor, Unalaska, although the stations in Prince William Sound were but little inferior, and Sitka was found to possess an extremely rich littoral fauna.

Of the abundance of Nemerteans collected, colored drawings were made of most of the species, and many specimens were carefully preserved for anatomical study, and have proved most interesting. Serial sections of most of the species have been prepared, and details of their anatomy will be found on subsequent pages.

Two other members of the expedition, Prof. William E. Ritter, of the University of California, and Prof. Trevor Kincaid, of the University of Washington, have generously submitted to me the Nemerteans collected by them.

SPECIES PREVIOUSLY RECORDED.

The Nemertean fauna of the northwest coast of North America up to the present time has been almost entirely neglected. Several small collections have been made, but the only literature relating to the group in this region seems to be a paper by Stimpson. This author¹ gives brief Latin diagnoses of the following species from the west coast of North America:

Emplectonema viride Stimpson [= *Nemertes gracilis* Johnston = *Emplectonema gracilis* Verrill]. Found by Stimpson under stones between tides in San Francisco harbor. This species occurs abundantly along the whole Pacific coast of Alaska.

Cosmocephala beringiana Stimpson [= *Amphiporus angulatus*]. Found in Bering Strait in five fathoms. This species also is abundant along the whole Pacific coast of Alaska.

Cerebratulus impressus Stimpson [= *Micrura impressa*]. Found in twenty fathoms in Bering Strait. This species was not met with by the Harriman Expedition.

The investigation of the systematic position and anatomy of this group of worms has been rendered much less difficult since the publication of Bürger's excellent monograph on the Nemerteans of the Gulf of Naples.² Bürger's classification is found to be admirable, and his nomenclature has been closely followed in the present work. It will be impossible, however, to retain the generic names *Eunemertes* and *Eupolia* which Bürger adopts, for the reason that they have been antedated by Stimpson. In

¹ Proc. Acad. Nat. Sci. Philadelphia, pp. 159-165, 1857.

² Fauna und Flora des Golfes von Neapel. Monogr., 22, 1895.

1857 Stimpson¹ published brief, though accurate, diagnoses of these same genera under the names *Emplectonema* and *Taniosoma*. Moreover, Stimpson gives as the type of *Emplectonema*, *E. camillea* [= *Borlasia camillea* Quatr. (1846) = *Amphiporus neesii* Oersted (1844) = *Eunemertes neesii* Vaillant (1890)]. Not only this species, but also Stimpson's other species, *Emplectonema viride* [= *Nemertes gracilis* Johnston, 1837], is a typical member of the genus named by Vaillant more than thirty years later. With these facts in mind it is obvious, as has been already pointed out by Verrill,² that Stimpson's name must be retained.

The status in regard to *Eupolia* Hubrecht (1887) is similar. Stimpson named *Borlasia quinquelineata* Quoy et Gaimard (1833) as belonging to his new genus *Taniosoma*, and described as new species *T. septemlineatum* and *T. æquale*, which is probably identical with *quinquelineatum* Quoy et Gaimard. But both of these species are typical of *Eupolia* Hubrecht. There can be no doubt, therefore, about the identity of the two genera³ and, as in the case of *Emplectonema*, Stimpson's name, *Taniosoma*, must hold.

The brevity of some of Stimpson's *generic* diagnoses, as mentioned above, is justified by the citation of well known typical species of those genera, and in such cases their validity cannot be questioned. Of his *specific* descriptions, on the other hand, it is more than likely that some will prove insufficient for an indisputable determination of the species.

In the preservation of the Nemerteans, I found a 2- to 5-percent solution of formalin in sea-water to yield most satisfactory results. Most forms die well-extended if a few drops of formalin are added to the water in the vessel in which the living worms are contained. The formalin solution preserves the general anatomical and some of the histological features excellently, and sharp nuclear stains are easily secured, especially with the epithelial structures. This solution, however, works

¹ Proc. Acad. Nat. Sci. Philadelphia, 1857.

² Trans. Connecticut Acad., VIII, p. 413, 1892; *ibid.*, IX, p. 146, 1895.

³ Bürger states distinctly in his great Monograph (p. 26) that "*Taniosoma* deckt sich mit *Eupolia*," but, for some reason, does not consider Stimpson's diagnoses valid.

havoc with the nervous elements and with the connective tissues. Specimens killed in strong alcohol proved valuable adjuncts to the formalin preparations. In most cases the formalin specimens have been eventually transferred to alcohol for permanent preservation. Corrosive sublimate-acetic, Gilson's fluid, and, for nervous elements, Flemming's solution are always to be recommended.

For serial sections no stains have given more happy results than Delafield's hæmatoxylin, followed by Orange G.

In the limited time at our disposal it was naturally impossible to make an exhaustive collection or study of the Nemertean fauna. Some thirty-two species were collected, however, and of these twenty-seven proved to be new to science, and only two of the remaining species have been recorded from the Pacific.

LIST OF SPECIES HERE RECOGNIZED.

Following is a list of the species recognized, with brief notes on their general distribution so far as our collections go:

PROTONEMERTEA.

1. *Carinella speciosa* sp. nov. Along the whole Pacific coast of Alaska. Vancouver Island (Shearer). Not uncommon.
2. *C. dinema* sp. nov. Victoria, B. C.; Sitka. Uncommon.
3. *C. capistrata* sp. nov. Prince William Sound. Common.

MESONEMERTEA.

4. *Cephalothrix linearis* (Rathke) Oersted. Pacific coast. Abundant.
5. *Carinoma griffini* sp. nov. Collected by Mr. Creswell Shearer at Albert Head, Vancouver Island.

METANEMERTEA.

6. *Emplectonema gracile* (Johnston) Verrill. Pacific coast. Abundant. San Francisco (Stimpson).
7. *E. bürgeri* sp. nov. Glacier Bay; Sitka. Not common.
8. *Zygocnemertes thalassina* sp. nov. Sitka. Not uncommon.
9. *Z. albida* sp. nov. Victoria, B. C. Uncommon.
10. *Paranemertes peregrina* gen. et sp. nov. Pacific coast. Vancouver Island (Shearer). Abundant.
11. *P. pallida* sp. nov. Yakutat Bay; Popof Island. Uncommon.

12. *P. carnea* sp. nov. Pacific coast. Vancouver Island (Shearer). Common.
13. *Amphiporus angulatus* (Fabricius) Verrill. Pacific coast. Abundant.
14. *A. bimaculatus* sp. nov. Southeast coast. Uncommon. Puget Sound (T. Kincaid).
15. *A. tigrinus* sp. nov. Farragut Bay. Uncommon.
16. *A. nebulosus* sp. nov. Kukak Bay, Alaska Peninsula. Uncommon.
17. *A. leuciodus* sp. nov. Southeast coast. Common.
18. *A. exilis* sp. nov. Pacific coast. Abundant.
19. *Tetrastemma bicolor* sp. nov. Kadiak. Not common.
20. *T. aberrans* sp. nov. Glacier Bay; Prince William Sound. Uncommon.
21. *T. cæcum* sp. nov. Dredged by Dr. Ritter at Kadiak. Common.

IIETERONEMERTEA.

22. *Tæniosoma princeps* sp. nov. Southeast coast. Uncommon.
23. *Lineus viridis* (Fabricius) Verrill. Annette Island. Common.
24. *L. torquatus* sp. nov. Prince William Sound. Common.
25. *Micrura verrilli* sp. nov. Prince William Sound. Not uncommon.
26. *M. alaskensis* sp. nov. Southeast coast. Common.
27. *Cerebratulus herculeus* sp. nov. Sitka. Not uncommon.
28. *C. marginatus* Renier. Sitka. Not uncommon.
29. *C. occidentalis* sp. nov. Yakutat; Prince William Sound. Vancouver Island (Shearer). Abundant.
30. *C. longiceps* sp. nov. Yakutat. Uncommon.
31. *C. montgomeryi* sp. nov. Puget Sound to Unalaska Island. Common.
32. *C. albifrons* sp. nov. Near Sitka. One specimen.

It must be remembered that the above list represents but a few weeks' collecting, and sometimes with only a few hours at a locality; too much confidence therefore should not be placed on the distribution or comparative abundance of the various species. Further research will undoubtedly add greatly to the number of species, and judging from the number found in so short a time it seems not unlikely that the list may eventually be more than doubled.

General considerations in regard to the anatomical peculiarities of the Nemerteans described below are reserved for a future paper. My reason for postponing this important duty in connection with the study of the collection is that since this article was written, extensive collections of Nemerteans from the west and northwest coasts of America and the Pacific Ocean have been placed in my hands. These collections will doubtless include other forms than those collected on the Harriman Expedition, and it seems desirable that as many as possible be studied before drawing any general conclusions in regard to the anatomical peculiarities presented by the Alaska forms.

KEYS TO GROUPS AND SPECIES.

For convenience in determination, the species at present known from the northwest coast of America may be arranged in the following analytical table, based mainly on superficial and easily distinguishable characters.

A. Proboscis without stylets. Mouth posterior to brain. Intestinal cæcum absent.

a. Lateral nerves external to musculature of body walls.

PROTONEMERTEA.

aa. Lateral nerves imbedded in or between muscular layers of body walls

b. Musculature of body walls in two main layers, to which an inner circular layer is sometimes added in the esophageal region. Cerebral sense-organs absent.....MESONEMERTEA.

bb. Musculature of body walls in three main layers, of which the inner is longitudinal. Cerebral sense-organs present.

HETERONEMERTEA.

AA. Proboscis with stylets. Mouth in front of brain, usually opening with proboscis in a single terminal or subterminal pore. Intestinal cæcum present. Lateral nerves internal to muscular layers of body walls.....METANEMERTEA.

ORDER PROTONEMERTEA.

Body remarkably long, soft, and fragile. Head distinctly marked off from body, usually broader than neck, often flattened dorso-ventrally.....*Carinella*, p. 11.

1. Body very soft, attaining a length of upwards of 2 meters, deep red or bright vermilion.....*C. speciosa*, p. 11

2. Color brown or chocolate with numerous narrow, transverse white rings and five parallel, longitudinal white lines, of which one is in the dorso-median line, and two on each lateral surface.....*C. dinema*, p. 15.
3. Color brown with numerous narrow transverse rings and three parallel, longitudinal white lines of which one is in the dorso-median line and one just below each lateral margin.....*C. capistrata*, p. 16.

ORDER MESONEMERTEA.

- A. Body musculature consists of a thin outer circular layer and a strong inner longitudinal layer—an inner circular layer is usually wanting entirely, or, if present, is much reduced. Body long and filiform, often coiled in a close spiral. Head sharply pointed. Mouth placed very far behind the brain. Nephridia not discovered*Cephalothrix*, p. 19.
1. Slender, filiform, pale yellow, sometimes with reddish, grayish or greenish tinge. No ocelli in adult.....*C. linearis*, p. 19.
- AA. Body musculature consists of a thin outer circular layer, a diagonal layer, a longitudinal layer, and, in the esophageal region, an additional, enormously developed inner circular layer. Head broader than neck. Nephridia well developed.
- Carinoma*, p. 20.
1. Body rather stout, flattened posteriorly. Mouth close behind brain. Milk-white with grayish or brownish mottlings, and darker intestinal lobes.
C. griffini, p. 20.

ORDER METANEMERTEA.

- A. Body long and slender. Proboscis sheath usually less than half the length of body. Proboscis small; central stylet usually small*Emplectonema*, p. 23.
1. Stylets slender, curved. Dark green or pale green above, and whitish or very pale greenish below.....*E. gracile*, p. 23.
 2. Stylets straight and short, with swollen bases. Basis of central stylet swollen and rounded posteriorly. Dark brown above, flesh-color beneath...*E. bürgeri*, p. 25.
- AA. Body moderately elongated. Proboscis sheath about $\frac{1}{2}$ to $\frac{3}{4}$ the length of body. Central stylet well developed.
- Paranemertes*, p. 32.
1. Two or 4 pouches of accessory stylets. Color purplish brown, dark-brown, or orange-brown above, on sides, and on lateral margins of ventral surface; rest of ventral surface (often only the median third) white or yellowish white.....*P. peregrina*, p. 33.
 2. Four pouches of accessory stylets. Opaque white.....*P. pallida*, p. 36.

3. Six to 12 pouches of accessory stylets. Whitish, pinkish or flesh-color..... *P. carnea*, p. 37.

AAA. Body commonly rather short and thick. Proboscis sheath usually reaches nearly or quite to posterior end of body. Proboscis large; central stylet well developed.....a

- a. Ocelli numerous, extending along the lateral nerves beyond the brain. Basis of central stylet massive, with truncate or concave posterior end..... *Zygonemertes*, p. 28.

1. Each of the 2 pouches of accessory stylets contains about 5 stubby stylets. Olive green above and below..... *Z. thalassina*, p. 29.
2. Each pouch of accessory stylets contains 2 or 3 moderately slender stylets. White..... *Z. albida*, p. 31.

aa. Ocelli do not extend posteriorly beyond the brain. Basis of central stylet usually rounded posteriorlyb.

- b. Body not very small. Ocelli usually numerous.

Amphiporus, p. 40.

1. Short and broad. Usually two pouches of accessory stylets with 5 to 7 rather slender stylets each. Dark purplish or chocolate-brown above, with a triangular white spot on each side of the head; ventral surface pinkish or flesh-color..... *A. angulatus*, p. 41.
2. Basis of central stylet but half as long as the slender stylet itself. Usually 4 pouches of accessory stylets. Dorsal surface deep brownish orange with 2 conspicuous oval or dark brown spots on head; ventral surface pale orange or flesh-color..... *A. bimaculatus*, p. 44.
3. Body rounded. Color of females yellowish orange, obscured in intestinal region (in breeding season) by dark-green ova. Males yellowish, with white flecks..... *A. tigrinus*, p. 46.
4. Body rather broad and flat. Whitish, thickly mottled with dark brown blotches and dots; ventral surface whitish..... *A. nebulosus*, p. 48.
5. Body slender, rather small. Ocelli usually 15-40. Usually 3 pouches of accessory stylets, with 2 or 3 stylets each. White.

A. leuciodus, p. 51.

6. Body extremely elongated for the genus. Ocelli usually 60-250, or more. Usually 6 to 12 (most commonly 8) pouches of accessory stylets, with 1 or 2 stylets each..... *A. exilis*, p. 54.

bb. Body very small. Ocelli few; usually 4 well-developed ocelli arranged in a rectangle; but sometimes these 4 eyes are double or are fragmented into 4 groups of ocelli; occasionally ocelli are wanting..... *Tetrastemma*, p. 57.

1. Ocelli 4. Brownish-red above, with median, white stripe; ventral surface white..... *T. bicolor*, p. 57.
2. Ocelli of 4 groups, each consisting of several pigment spots of irregular size. Pale yellow..... *T. aberrans*, p. 58.
3. Ocelli wanting. Hermaphroditic. Whitish..... *T. cæcum*, p. 59.

ORDER HETERONEMERTEA.

- A. Head without deep lateral, longitudinal furrows. Proboscis musculature of two layers..... *Tæniosoma*, p. 61.
1. Of very large size, reaching a length of 2 meters and a diameter of 18 mm. Deep yellow, thickly sprinkled with small irregular, dark red spots.
T. princeps, p. 62.
- AA. Head with deep, horizontal furrows. Proboscis usually with three muscular layers and muscular crossings.
- a. Caudal cirrus absent. Body long and slender, rounded or flattened; very contractile..... *Lincus*, p. 64.
 1. A single row of 4-6 (or sometimes 8) ocelli on each side of head. Dusky, or brownish green, dark brown, or reddish brown; commonly paler beneath *L. viridis*, p. 65.
 2. No ocelli in adult. Dark, reddish brown or purple, with a narrow transverse white band connecting posterior ends of cephalic furrows across dorsal surface of neck..... *L. torquatus*, p. 66.
 - aa. Caudal cirrus present. Body rather firm; incapable of swimming..... *Micrura*, p. 68.
 1. Dorsal surface deep purple or wine-color with 15-40 sharp, pure white, transverse lines; tip of snout with triangular, bright orange spot; ventral surface of body pure white..... *M. verrilli*, p. 68.
 2. Body flattened, grayish brown above with narrow, colorless, transverse lines; with a small, flesh-colored, sub-truncate head, much narrower than body, and with minute gray spots near antero-lateral margins.
M. impressa,¹ p. 70.
 3. Salmon or flesh-color (more rarely light brownish); lighter, with tinges of brighter red, or nearly colorless anteriorly. Intestinal lobes more deeply colored, sometimes chestnut-brown. A cream-colored stripe is conspicuous in the ventral median line..... *M. alaskensis*, p. 71.
 - aaa. Caudal cirrus present in perfect specimens, but often missing. Body long and flat, with thin lateral margins. Swims readily. Dorso-ventral and diagonal muscles well developed. Eyes usually absent..... *Cerebratulus*, p. 74.
 1. Very large and stout, becoming 2 meters or more in length, and 25 mm. in width. Dark, reddish brown..... *C. herculeus*, p. 75.
 2. Large and ribbon-like. Slaty brown to grayish green, with thin, white, lateral margins..... *C. marginatus*, p. 75.
 3. Rather short. Chestnut-brown or reddish brown in esophageal region, chocolate-brown in intestinal region above; brownish flesh-color to dark brown beneath, with a median longitudinal ochre stripe along ventral surface..... *C. occidentalis*, p. 76.

¹Known only from Stimpson's original description—Proc. Acad. Nat. Sci., Philadelphia, p. 160, 1857.

4. Head and anterior portions of body narrow and slender, with remarkably long and deep cephalic furrows. Dark brown or purplish, paler on borders of cephalic slits and tip of snout.....*C. longiceps*, p. 77.
5. Very long and ribbon-like, becoming 2 meters or more in length. Deep blood-red except tip of snout, which is yellowish white both above and below*C. montgomeryi*, p. 80.
6. Reddish purple except head which is white on both dorsal and ventral surfaces back to anterior border of mouth.....*C. albifrons*, p. 82.

SYSTEMATIC DISCUSSION OF GENERA AND SPECIES.

CARINELLA Johnston.

Mag. Nat. Hist. London, VI, p. 232, 1833.

The species belonging to this genus are characterized by a slender, soft, rounded body, capable of extending and contracting to a remarkable degree. Head distinctly marked off from body, usually much broader than parts immediately following, often flattened dorso-ventrally, and disk-like.

On each side of body a transverse furrow separates the head from the esophageal region. Proboscis opening subterminal; mouth a small round opening on ventral surface just back of lateral transverse furrows. The lateral nerves lie outside the muscular layers of the body, and just beneath the basement layer of the integument. The body walls are made up of a very thick outer epithelium with abundant glands, a basement layer, a circular muscular layer, and a longitudinal muscular layer in the order named from without inwards. In addition to these there is, in the esophageal region, an inner circular muscular layer which often forms a dorsal, and sometimes a ventral crossing with the fibers of the outer circular muscular layer.

Proboscis sheath usually not more than $\frac{1}{3}$ the length of body. Proboscis small and short. Ocelli wanting. Cerebral sense organs usually represented simply by a pair of sensory pits in the epithelium, although some species (cf. *C. speciosa*) possess a pair of well-developed sense organs with ciliated canal, ganglion cells and glands. A pair of peculiar lateral sense organs is usually situated well back in the esophageal region. Some of the species show elaborate markings of fine white lines on a brownish body, others are homogeneous in color. Most species are colored in some shade of brown or red; some are bright vermilion.

i. CARINELLA SPECIOSA sp. nov.

Pl. III, fig. 6; Pl. IX, figs. 1-3; Pl. X, figs. 1, 2.

Body large, very long, flattened below, rounded above, and remarkably soft and pliable. This beautiful Nemertean closely resembles *C.*

polymorpha in external appearance, but is more brightly colored, and shows conspicuous peculiarities in its internal anatomy. The body is even softer than that of *C. polymorpha*, and more distensible; and the species is easily distinguished by the presence of enormously developed cephalic glands, by having very highly specialized and sharply defined cerebral sense organs (with ciliated canal, lined with glandular and sensory cells), by the peculiarities in the nephridia, and by many other details of structure.

Head rounded in front, broader than parts immediately following, from which it is marked off by lateral, transverse furrows. Proboscis opening and mouth as in other species of the genus. Body variable in thickness in its different portions according to state of contraction of the particular part, but usually flattened below and rounded above, with well-rounded lateral faces; posterior portion of body much more slender than anterior.

The worms are very sluggish. When coiled together the turns of the body are irregular and angular.

Color.—This is the most brilliantly colored and unquestionably the most striking Nemertean encountered on the expedition. The color of the whole body was a deep, rich vermilion, becoming somewhat paler and more yellowish towards the posterior end. In formalin or alcohol the natural color quickly disappears, although a characteristic marking still remains. This feature is peculiar to *C. polymorpha* as well. About 25 to 40 mm. back from the tip of the head (in a large specimen) is a broad band of dark brown color reaching entirely around the body. This band is commonly 10 to 30 mm. in width, is very sharply marked off anteriorly, but fades out gradually behind. All the rest of the body, both in front and behind, is yellowish or grayish. This marking remains after imbedding in paraffin, and even after sectioning and staining in hæmatoxylin there is a sharp line of distinction at the anterior end of the dark band. A single section, cut obliquely, shows the line of demarkation perfectly. The difference lies wholly in the integument and does not affect any of the layers beneath. In the integument the dark band is characterized not only by the presence of an abundance of minute pigment granules, but by a decided change in the staining qualities of the closely packed gland cells.

Size.—The body is very long, one specimen measuring—when suspended by its middle portion, and therefore well extended—fully three meters in length, and about 5 mm. in width. Most specimens, however, were not more than $\frac{1}{4}$ as long.

The epithelium of the body is very thick, and filled with closely packed gland cells. The two circular muscular layers in the esophageal region show almost no indication of a mutual crossing of fibers either above or below, although, as indicated in pl. ix, fig. 3, a few fibers of connective tissue and fine nerve fibers pass at intervals from the region of the median dorsal nerve to the internal circular muscles.

Proboscis.—Attached to tissues of head just opposite the mouth, and therefore a considerable distance back of the brain commissures. Its posterior attachment is in the region of the efferent nephridial ducts. The muscular layers are as in other species of the genus. Two large nerves enter the latero-ventral portion of the proboscis at its attachment, and pass backwards on opposite sides just internal to the circular muscular layer.

The *proboscis sheath* shows a homogeneous basement layer beneath its internal lining of flattened epithelium. The musculature consists wholly of circular fibers, except that there is a distinct layer of longitudinal muscles between the circular muscles of the proboscis sheath and the epithelium of the esophagus. Lying on the muscles of the proboscis sheath is a small median dorsal nerve which runs parallel with the median nerve outside the circular body-muscles and corresponds to the inner median nerve of other species.

The esophagus is provided with a pair of nerves continuous with the unusually large buccal nerves. The cerebral ganglia are situated wide apart, as in other species. The anterior portion of the head receives a considerable number of remarkably large nerves (pl. ix, fig. 1).

Cerebral sense organs.—These organs deserve special attention because of their high degree of development. They are each provided with a narrow but distinct canal leading outward to the lateral surface of the integument. The sense organs lie immediately external to the dorsal ganglia, from which they are separated only by a few fibers of connective tissue which here represent the integumental basement membrane (pl. x, fig. 2). In size, position and structure these organs are closely similar to those of *C. annulata*, as figured by Bürger.¹ Each consists of a large, rounded mass of nerve cells and connective tissue surrounding a narrow, central canal lined with ciliated and specialized sensory epithelium (pl. ix, fig. 2). Peripherally there is an abundance of peculiar glandular cells, and the whole is separated from the surrounding integumental cells by a thin

¹Fauna und Flora des Golfes von Neapel, Monogr. 22, pl. xii, fig. 5.

sheath of connective tissue. The central canal leads ventrally and outwards to open through the epithelium of the lateral margin of the head. The sense organs are innervated by several large nerves from the adjacent dorsal ganglion (pl. x, fig. 2).

Cephalic glands.—Enormously developed, making up a large portion of tissues of snout (pl. ix, fig. 1). These glands are closely packed throughout the tissues internal to the integument, and form thick layers around the cephalic blood lacunæ and the rhynchodæum. Nearer the brain region they become more scattered, and disappear just in front of the ganglia, those about the rhynchodæum reaching back a little farther than those situated external to the blood lacunæ. The secretion from the glands stains most intensely with hæmatoxylin. Most of the anterior glands pour out their secretion on the tip of the snout; those farther back open along the whole circumference of the body, but most abundantly near the lateral margins (pl. ix, fig. 1). Still farther back all the glands open laterally.

Nephridia.—Situated mainly in, and a little behind, middle third of esophageal region. There is a single large longitudinal canal on each side, lying in close contact with the dorsal walls of the large, lateral blood lacunæ (pl. ix, fig. 3). The nephridial canals reach forward about as far as the anterior end of the broad band mentioned above as becoming darkly colored in alcohol. Near its posterior end each canal exhibits a peculiar relation with the outer integument. At several points in each canal the dorsal wall of the canal becomes discontinued and the inner ends of the integumental cells reach inward into the lumen of the canal (pl. x, fig. 1). Sometimes this infolding of the integumental cells occupies a large part of the lumen of the nephridial canal. Superficially these areas always show one or more openings in the outer layers of the integument, but such openings do not penetrate the nephridial canal. At the posterior end of each nephridial canal there is one, or sometimes two, efferent ducts (pl. ix, fig. 3) which lead to the dorso-lateral surface of the body, as in other species.

Habitat.—The species was found at Hot Springs (near Sitka), Virgin Bay in Prince William Sound, and at Dutch Harbor, Unalaska.¹ Individuals were occasionally seen crawling about on the bottom beneath the water, and in such instances were extremely conspicuous, because of their large size and brilliant vermilion color. They were more commonly found under stones near low-water mark, but were nowhere abundant.

¹ Collected also by Mr. Shearer at Vancouver Island, B. C.

2. *CARINELLA DINEMA* sp. nov.

Pl. I, figs. 2, 3.

This species somewhat closely resembles *C. superba* in general color of body and the thread-like markings thereon. It differs from this and allied species in many details, and especially in having *two* lateral longitudinal white lines on each side—hence the specific name.

Body long and slender, largest in esophageal region, rounded anteriorly, somewhat flattened on ventral surface posteriorly. Head broad, flat, often emarginate in front; lateral, transverse furrows back of head deep and conspicuous. Proboscis-pore subterminal. Mouth rather large for the genus, elongated and situated slightly in front of second white ring.

Color.—General color dark brown with a more or less pronounced yellowish tone, becoming more nearly yellow posteriorly. The markings of fine longitudinal and transverse white lines on this ground color are very characteristic and stable. Five parallel, longitudinal lines run nearly the whole of the length of the body, and there are a great number of transverse lines. Of the five longitudinal lines, one lies in the middle of the dorsal surface and extends from the most anterior transverse ring to the posterior end of the body. The other four lie symmetrically on the sides—two almost on the lateral margins; the other two much nearer the ventral surface. Seen in section, the distance between the dorsal median line and the upper of the two lateral lines on each side is 90° . Two lateral lines on either side are separated by about 45° , while the remaining 90° lies between the two lower lateral lines. All the four lateral lines extend from the second transverse line to about $\frac{3}{4}$ the distance towards the posterior end of the body. Here they become interrupted, and back of this they are usually indicated only by short segments and scattered dots, though their course may be traced nearly to the end of the body. The five longitudinal lines are all very fine and sometimes consist of rows of fine white dots closely placed together. In addition to these five longitudinal lines some individuals show an indication of a median ventral longitudinal line in the form of a row of isolated fine white dots extending from behind the mouth nearly to the fifth white ring.

The first transverse white marking lies near the tip of the snout. It is somewhat wavy in outline and does not reach below the lateral margin. The second white marking is broader than the first, but is likewise limited to the dorsal surface. It is indicated, however, on the lateral surface by two narrow and inconspicuous spots. The third

marking is not represented on the lateral surfaces, but is sharp on the dorsal surface, and is indicated on the ventral surface by a few scattered white dots. The fourth marking is very sharp and extends as a ring completely around the body. The fifth is broader than any of the other rings. The sixth is usually merely indicated by a series of fine dots. Posterior to the sixth, there are commonly as many as 150 more or less distinct and perfect rings, arranged at fairly regular intervals throughout the length of the body. They are much more conspicuous on the dorsal than on the ventral surface. In fact a large number of them are interrupted on the ventral surface and represented only by isolated dots. When the rings are well developed each consists of two very fine white rings lying side by side, with a fine brown ring between them. Over the greater portion of the body are alternating wider and narrower white rings, or double and single rings, but there are always exceptions to the regularity of arrangement. The white lines, both longitudinal and transverse, appear as if formed by a coating of fine white particles on the surface of the body.

The region of the proboscis-pore is very pale. Extending outward and backward on each side from a point just above the proboscis-pore is a shallow, horizontal groove. Each of the grooves is marked by a black line, and each extends backward as far as the first transverse white line. They do not quite meet in front however. The borders of the mouth are pale in color. The sides of the brain region are dark reddish.

In alcohol the body is grayish as far back as the fourth white ring. Here it abruptly changes to black, which fades into dark brown throughout the remainder of the body. The markings are well preserved.

The '*side organs*' are indicated as a pair of rounded pits lying just anterior to the fifth white ring and immediately below the dorsal of the two white, lateral, longitudinal lines on each side.

Habitat.—This species was found on the piles of a wharf at Victoria, B. C., and was also found among hydroids, etc. at Sitka. The worms were from 300 to 500 mm. long in extension, with a diameter of about 2 to 3 mm. They inhabited grayish, fragile, parchment-like tubes, which were commonly much twisted and coiled. But few specimens were met with.

3. *CARINELLA CAPISTRATA* sp. nov.

Pl. 1, fig. 1.

This, like the preceding species, resembles *C. superba* (Kölliker) Bürger somewhat closely in color and general appearance. A careful

examination of a number of individuals, however, shows that the markings on the body present such constant differences that the two species must be considered distinct. *C. capistrata* is likewise different from any of the other related and described species. It may at once be distinguished from *C. superba* by lacking all indications of a median ventral white line. The markings on the head and the arrangement of the anterior transverse white lines distinguish it easily from *C. annulata* and *C. nothus* Bürger; from *C. dinema* it may be separated by the presence of but one pair of lateral white lines, instead of the two pairs found in *C. dinema*.

C. capistrata is a very large species, attaining a length of more than a meter with a diameter of about 5 mm. near the anterior end, and of 2 to 3 mm. farther back. The worms are therefore extremely long and slender, and the diameter in the esophageal region is twice as great as it is farther back. The body is strongly rounded on the dorsal surface throughout its whole length; the posterior end is very slender and easily broken.

Head broad, flattened dorso-ventrally, rounded or emarginate in front, sharply marked off from succeeding portions by a pair of deep, lateral, transverse constrictions, or furrows. Proboscis-pore minute, subterminal, bounded on each side by a shallow horizontal groove. Mouth small, slightly elongated, situated immediately behind the lateral furrows.

Color.—General color of body rich, deep brown, sometimes varying towards grayish black; posteriorly becoming lighter, and of a yellowish brown. On this ground color is a series of conspicuous, but fine, longitudinal and transverse white lines (pl. I, fig. 1). The longitudinal lines are three in number and parallel—one in the middle of the dorsal surface, the others just ventral to the lateral margins. The dorsal line extends without interruption from near the tip of the head to the posterior end of the body. The lateral lines, on the other hand, are much broken up in the anterior portions of the body, and in the esophageal region are only indicated at intervals, though their course can be followed nearly to the head; throughout all the rest of the length of the body they are sharp and distinct.

The transverse white lines, excepting the most anterior one, completely encircle the body. This first transverse line appears as a sharp V-shaped marking a little back of the head. Its angle is directed backward and its extremities reach but little below the lateral margins. The median dorsal line passes through the angle of this V-shaped marking, and at the point of intersection the white area is somewhat

enlarged to form a small oval spot. The second transverse marking is situated some 20 to 30 mm. (in large individuals) from the first, and completely encircles the body. This ring is always sharp and conspicuous, and in alcoholic specimens is still more distinct in that it separates a paler anterior portion from the much darker succeeding parts. The third transverse ring is also complete, and is commonly separated from the second by about half the distance that this is separated from the first. The fourth and fifth rings are sometimes interrupted below, but are more usually complete, and are much nearer together than the second and third. Back of the fourth or fifth ring we find a regular succession of complete rings to the end of the body. It is common to find as many as 200 such rings arranged at fairly regular intervals and separated from each other, when the worm is contracted, by an average distance of about the diameter of the body. Some of the rings are wider than others, but nearly all are as narrow as fine threads; a few are more or less interrupted.

The anterior and lateral margins of the head are bordered by a narrow band of light color, as in several other species, but this is mainly visible from the ventral surface.

The '*side organs*' are indicated by a pair of small pits situated in the third transverse white ring and just dorsal to the position of the lateral lines. Their position is about the same, therefore, as in *C. superba*.

In alcoholic specimens the arrangement of the white longitudinal and circular lines is still distinguishable, except near the anterior end of the body, which, back to the second transverse marking (first complete ring), is pale or grayish brown. Back of this the color abruptly changes to very dark brown or black, which reaches posteriorly 50 to 75 mm. (in large individuals) and then gradually fades out into light brown, which continues to the end of the body. The color is usually paler on the ventral than on the dorsal surface.

Habitat.—This species was found in abundance under stones near low-water mark at Orca and Virgin Bay in Prince William Sound, but was not met with elsewhere. The worms lived in long, fragile, grayish, paper-like tubes of about the same diameter as the body. These tubes were usually twisted about horizontally beneath the stones under which the animals live. They were also frequently occupied by a species of polychætous annelid (*Nereis*), which was often associated with the Nemertean. The worms are sluggish in their movements, and break up posteriorly if roughly handled.

CEPHALOTHRIX Oersted.

Entwurf der Plattwürmer, Kopenhagen, 1844.

This genus includes very long, slender, filiform species which show a tendency to coil in a close spiral. Brain situated well behind tip of snout; mouth several times as far posteriorly. Head sharply pointed in extension; proboscis-pore on ventral side a little back of its extremity. Inner circular muscular layer very much reduced, or (commonly) entirely absent, the body musculature consisting of a thin outer circular muscular layer and a strong inner longitudinal layer; lateral nerves situated in the longitudinal muscular layer; cerebral sense organs and cephalic furrows wanting. These worms resemble in external appearance some of the slender Nematodes.

4. CEPHALOTHRIX LINEARIS (Rathke) Oersted.

Planaria linearis RATHKE, Skrivter af Naturhist. Selsk. Kjöbenhavn, v, p. 84, 1799.

Cephalothrix linearis OERSTED, Entwurf der Plattwürmer, p. 82, Kopenhagen, 1844.

A very slender thread-like species capable of great extension and contraction. Individuals may be extended till they resemble a very fine thread, but when disturbed commonly coil themselves into a closely wound spiral. Body commonly rather thicker in the middle and tapering toward both extremities. Head very long, acutely pointed when extended. Proboscis-pore situated ventrally, some little distance back from tip of snout. Mouth very far back; commonly distant from tip of snout 10 to 12 times the diameter of body; or it is perhaps 4 to 5 times as far back as is the brain.

The length is subject to the greatest variation. Alaska specimens commonly extended themselves 3 to 6 inches or more, but could contract to a small fraction of this length.

Ocelli.—Wanting in adults although the embryos are provided with a single pair soon after leaving the egg.

Color.—Usually pale yellow throughout, but some specimens had a distinct reddish tinge, and some were gray, greenish, or pale green. A median paler line, due to the proboscis sheath, appears on the dorsal surface in the esophageal region.

Habitat.—The species is very common well up toward high-water mark under stones in muddy places, among decaying mussels, etc. The worms were commonly found where the mud was black, slimy, and very foul. Scores of specimens were sometimes found under a single stone. They were often associated with slender red-

dish Nematodes. Very abundant at New Metlakahtla, Glacier Bay, Sitka, Orca and at other places. The species is also common on the coast of New England, and is likewise found along the shores of northern Europe and in the Mediterranean.

CARINOMA Oudemans.

Circulatory and Nephridial Apparatus of the Nemertea, Quart. Journ. Micr. Sci., xxv, Suppl., pp. 1-80, 1885.

Body usually slender, often thickened and rounded anteriorly, flattened in intestinal region; head usually wider than parts immediately following; mouth situated immediately behind the brain; proboscis pore subterminal. Lateral slits, cephalic groves, and cerebral sense organs wanting. Intestine with paired, lateral diverticula.

Body musculature composed of two muscular layers throughout length of body, and of localized supplementary layers. These consist of a thick internal longitudinal layer and a thin external circular layer, but in the esophageal region a second circular layer lies internal to the longitudinal muscles, and just in front of the nephridial region becomes enormously thickened. In the anterior portions of the esophageal region a double set of distinct diagonal muscles lies just internal to the outer circular muscular layer.

The lateral nerves are situated within the longitudinal muscular layer.

In the anterior portions of the esophageal region are three pairs of longitudinal blood vessels, of which one pair represents the main lateral vessels and lies beside the esophagus, a second pair lies beside the proboscis sheath, and the third pair is situated internal to the ventral wall of the proboscis sheath and projects freely into the rhynchocœl.

5. CARINOMA GRIFFINI sp. nov.

Two¹ species of this interesting genus are already known from other parts of the world—*C. armandi* Oudemans, which is found

¹Miss C. B. Thompson has very recently added a third species, *C. tremaphoros* (Zool. Anz., Vol. xxiii, No. 631, pp. 627-630, Dec., 1900, from a single specimen collected at Woods Hole, Mass. I have found this species rather abundantly in a large pond at Falmouth, Mass., connected with Vineyard Sound by a very narrow outlet, and consequently but little affected by the tides. The species must be unusually hardy, for the worms lived just on the edge of the pond in sand much blackened by decaying organic matter. They have moreover to endure great changes in the salinity of the water due to irregularity in rainfall and evaporation. Further notes in regard to the anatomy of this species will be published later, together with colored figures of the living worms.

occasionally on the shores of England, and *C. patagonica* Bürger, of which a single specimen has been collected from the Straits of Magellan.

This new species was found by Mr. Creswell Shearer at Albert Head on Vancouver Island. It attains a length of upwards of 600 mm. and a diameter of 3-5 mm. Anterior portions of body cylindrical; intestinal region much flattened. Head broader than neck, and pointed, rounded or emarginate in front according to the state of contraction (figs. 1 and 2).

No ocelli were found.

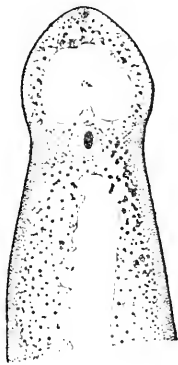


FIG. 1.

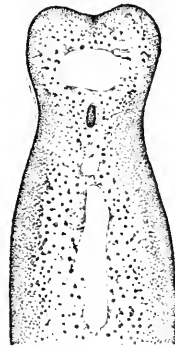


FIG. 2.

FIGS. 1 and 2. *Carinoma griffini* sp. nov. Anterior part of ventral surface. 1. Head extended and pointed. 2. Head contracted and emarginate. $\times 8$.

Color.—General color milk-white anteriorly, with brownish mottlings farther back; intestinal lobes darker. After preservation the color is completely lost, and the body becomes nearly cylindrical throughout.

Body walls.—In internal organization this species agrees closely with the descriptions which Bürger gives of *C. armandi*¹ and of *C. patagonica*,² but presents a number of peculiarities, which may be stated briefly as follows: Outer integument divided into a superficial and a deeper layer of epithelial cells, separated by a network of connective tissue fibers. Basement layer in esophageal region about equal in thickness to the integument itself, but is much thinner farther back. Beneath basement layer in esophageal region is a loose sheet of circular muscles, and beneath this a double set of diagonal muscular fibers.

¹Fauna u. Flora des Golfes von Neapel, Monogr. 22, Nemertinen, 1895.

²Zeits. f. wiss. Zool., Vol. LXI, pp. 19-20, pl. 3, figs. 1-9, 1896.

The main longitudinal muscular layer in most regions of the body equals in thickness that of all the other muscular layers combined. The lateral nerve cords lie imbedded in this layer. Internal to the longitudinal muscles lies a small amount of gelatinous tissue or parenchyma of the body cavity. The inner circular muscular layer extends from the mouth to the posterior end of the esophageal region. Its fibers are continuous with those of the proboscis sheath. Anteriorly, it is even thinner than the outer circular muscular layer, but towards the posterior end of the esophageal region it increases so greatly in massiveness that for a short distance it exceeds in thickness the other muscular layers combined. Having reached its maximum development (near the efferent nephridial ducts), it suddenly disappears entirely, its dorsal portion remaining for a few sections as a semicircular arch above the proboscis sheath.

Proboscis sheath.—This organ is more strongly developed than in the other species of the genus, and possesses a single muscular layer composed of circular fibers interlaced with longitudinal fibers in small groups.

Proboscis.—The anterior end of the proboscis is attached to the tissues of the head at about the middle of the brain region. Its walls consist of a thin outer fibrous layer, on which rest the superficial flattened epithelial cells bathed in the fluid of the rhynchocoel. Beneath is the thick layer of longitudinal muscles comprising nearly the whole of the musculature. Internal to these are a few scattered circular fibers, then a thin basement membrane, and, finally, the internal layer of columnar epithelial cells. This inner epithelium is composed of a simple layer of very long and closely pressed cells, a portion of which contain rod-like masses of secretion. Their nuclei are closely packed together peripherally, and comprise several layers as is usual in much crowded columnar cells.

A pair of rather large nerves extend throughout the length of the proboscis just internal to the circular muscular layer. These nerves originate from the ventral commissure of the brain very much as in *Carinella*. They arise from the anterior border of the commissure near its origin from the ganglia, and pass dorsally to the point where the proboscis is attached to the tissues of the head. They then enter the proboscis, and take up lateral positions in its walls corresponding to those of the lateral nerves in the walls of the body.

Nephridia.—The condition of the nephridial system is in many respects intermediate between that of *C. patagonica* and *C. armandi*, the mass of tubules constituting the so-called nephridial glands not ex-

tending into the cavity of the blood space nearly so far as in the former, but are much more profusely branched than in the latter species. The single pair of efferent ducts lies in the same region as the posterior ends of the series of 'nephridial glands.' Posteriorly to this point a single unbranched duct of large size runs backward on each side for a considerable distance, and then bends sharply and runs forward to the efferent duct, always lying close beside, and just external to that limb of the duct which is passing backward. The efferent ducts open on the dorso-lateral surfaces of the body at the posterior end of the enormously thickened internal circular muscular layer.

The blood vascular system, brain, buccal nerves, lateral nerves, and dorsal and ventral median nerves are much as in *C. patagonica*.

Specimens collected in August had just discharged their sexual products. In one individual a very few genital sacks still retained their mature ova.

EMPLECTONEMA Stimpson.

Emplectonema STIMPSON, Proc. Philadelphia Acad., p. 163, 1857.

Nemertes MCINTOSH, British Annelids, Part I, Nemerteans, Ray Society, 1872-1873.

Eunemertes VAILLANT, Hist. Nat. des Annelés, Tome 3, Paris, 1890.

Body very long and slender, varying greatly in thickness according to state of contraction, but most commonly considerably flattened; often sharply bent and folded into an irregular mass; integument provided with an unusual abundance of mucous secretion; proboscis and mouth opening together on subterminal portion of snout; proboscis sheath limited to anterior third of body; proboscis slender and very short, often not more than $\frac{1}{6}$ the length of body; a large number of minute eyes usually present; cerebral sense organs situated well in front of brain, and usually very small. The species are of sluggish movement, and many of them are found very near high water mark among mussels, barnacles, rockweeds, etc.

Of the genus *Emplectonema* two species, of which only one (*E. gracile*) had previously been described, were found on the Harriman expedition.

6. EMPLECTONEMA GRACILE (Johnston) Verrill.

Pl. VIII, fig. 3.

Nemertes gracilis JOHNSTON, Mag. Zool. and Bot. London, vol. 1, 1837-38.

Emplectonema viride STIMPSON, Proc. Philadelphia Acad., p. 163, 1857.

Eunemertes gracilis VAILLANT, Hist. Nat. des Annelés, Tome 3. Paris, 1890.

Eunemertes gracilis BÜRGER, Fauna u. Flora des Golfes von Neapel, Monogr. 22, Nemertinen, p. 543, 1895.

Emplectonema gracilis VERRILL, Trans. Connecticut Acad., VIII, p. 413, 1892; ix, p. 146, 1895.

Body very long and slender, somewhat flattened below, irregular and ungraceful in form, and sluggish in movement. Head slightly broader than rest of body; snout blunt, posterior extremity of body tapering gradually to a point.

The common opening of the mouth and proboscis lies ventrally, a little back from the tip of the snout. The cerebral sense organs lie far in front of the brain, and each communicates with the exterior by a canal which opens on the ventro-lateral margin near the tip of the snout.

Color.—Uniform dark green above and nearly white below; sometimes grayish or yellowish green above, and very pale yellowish green below. The color of Alaska specimens is as a rule paler and more grayish green than in Mediterranean specimens. The head is bordered with a narrow band of white, uniform with that of the lower surface. Back of the head is an inconspicuous transverse band paler than the rest of the dorsal surface. The pigment resides wholly in the integument, the muscular layers and other organs of the body being practically colorless.

Ocelli.—The eyes (fig. 3) are characteristically arranged in two groups on each side of the head. The anterior group on each side usually consists of 8 to 10 pigment-cups arranged in a single row near the antero-lateral border of the head. These lie deeply imbedded in the tissues of the head, and are much more conspicuous from the ventral surface owing to the presence of much pigment on the dorsal surface above them in ordinary states of contraction. Each posterior group lies nearly above the brain and consists of 10 to 20 ocelli in an irregular cluster. The eyes of the posterior groups are visible only from the dorsal surface, and are smaller in size than those of the anterior groups. The integument may be scraped off so as to expose the eyes clearly.

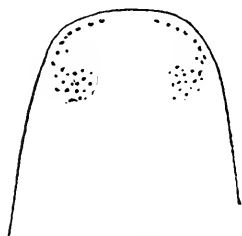


FIG. 3. *Emplectonema gracile*. Dorsal view of head to show arrangement of ocelli. $\times 12$.

Proboscis.—The stylet apparatus is especially characteristic of the species. The basis of the central stylet is very long and slender, and is twice to three times as long as the stylet itself. The posterior end is sharply swollen into a flattened knob (Pl. VIII, fig. 3). In front of the knob the basis decreases in diameter evenly towards the anterior end, except for a slight constriction which occurs at about $\frac{1}{3}$ the distance from the posterior end. The anterior portion is slightly

curved. The central stylet is slender, extremely sharply pointed, and gracefully curved like a sabre or scythe. There are two accessory stylet pouches, and each commonly contains 5 to 7 slender stylets curved like the central one, and of approximately the same size (Pl. VIII, fig. 3).

Habitat.—This species was found in the greatest abundance at nearly all the collecting stations between Victoria, B. C., and Dutch Harbor, Unalaska. It occurred everywhere along the shore, and was most plentiful near high water mark, crawling over the thick growth of mussels and seaweeds. Often a number of individuals were found coiled together in a single slimy mass, and on being disturbed would crawl apart and move sluggishly about, but usually made no effort at concealment. Similar masses were met with under stones in very muddy localities, and often where the water was very brackish. This is probably the most abundant species of Nemertean on the Alaska coast, and is found nearer high water mark and in more brackish water than almost any other species.

The species has previously been recorded from the coasts of England, the northern shores of Germany and France, the Mediterranean, and Madeira. It was also found by Stimpson under stones between tides in San Francisco harbor and described as *E. viride*.

An excellent and detailed account of the minute anatomy of this species is given in Bürger's Monograph of the Nemerteans of the Gulf of Naples.¹

Specimens collected in Alaska in June and July were filled with nearly mature genital products, in closely packed, but irregularly arranged pouches. The genital glands were often noticeable from the exterior because of their pale color.

7. EMPECTONEMA BÜRGERI sp. nov.

Pl. II, figs. 1, 2; Pl. VIII, fig. 1; Pl. XII, fig. 3.

Body long, flattened both above and below, ribbon-like, as thick near the edges as in the median line; head usually narrower than the parts immediately following; posterior extremity slender. The rhynchodæum opens on the ventral side of the tip of the snout; a pair of shallow lateral slits occur just in front of the mouth.

The worms attain a length of more than a meter, and are 5 mm. or more in width. Like other species of the genus the integument is furnished with a vast amount of mucus.

¹ Fauna u. Flora des Golfes von Neapel. Monogr. 22, 1895.

Color.—The color varies considerably, as will be seen from the two color varieties on pl. II, figs. 1 and 2. The commonest form is dark velvety-brown above, with a paler median line, much paler and slightly yellowish in front, and flesh-colored or creamy white below. Other individuals have the whole dorsal and lateral surfaces of a mottled reddish brown color, with a tinge of purple, while the ventral surface is pale yellow or flesh-colored. Sometimes the head is nearly colorless. The dorsal surface almost always has an appearance suggestive of velvet. This color is superficial, and is easily removed by rough handling.

Proboscis.—Proboscis small, very short and delicate, sometimes scarcely more than $\frac{1}{10}$ the length of body. The proboscis sheath reaches well toward middle of body, but is very small toward its posterior end; in esophageal region it is well developed, with a thick outer layer of circular muscles, and a thin, inner, longitudinal muscular layer. The rhynchodæum passes backward a considerable distance before the intestinal canal is separated from the proboscis opening.

The armature of the proboscis consists of a weak central stylet, and a pair of pouches of accessory stylets (pl. VIII, fig. 1). The basis of the central stylet is rather slender in front, slightly contracted near its posterior third, from which point it swells out suddenly into a large spherical bulb. The central stylet is slightly shorter than its basis. Each of the reserve pouches usually contains three small stylets with swollen bases. The posterior chamber of the proboscis is narrow. The proboscis is provided with 11 distinct nerves.

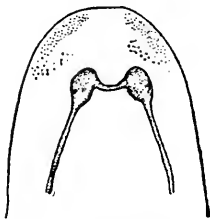


FIG. 4. *Emplectonema bürgeri*. Dorsal view of head to show arrangement of ocelli. $\times 8$.

Ocelli.—The ocelli are very numerous. On each side of the tip of the snout is an elongated cluster of minute eyes, all situated near the dorsal surface, and without regularity of arrangement. Their number is commonly 60 or more on each side (fig. 4). Back of these are a few

other eyes, likewise very minute, situated deep in the tissues of the body, and seen only with difficulty. They are scattered irregularly from near the lateral borders in front of the brain inward towards the median line (fig. 4).

Cerebral sense organs.—Unusually large. They lie lateral to the rhynchodæum, and slightly in front of the brain. The ducts by which they communicate with the exterior pass forward to open latero-ventrally.

The pair of *blood lacunæ* in the head are rather small, and pass backward in numerous branches. The dorsal vessel in the proboscis sheath has several communications with the lateral vessels in the esophageal region.

In the region of the brain a great abundance of *sub-muscular glands* appears, occupying the whole lateral aspects of the body and reaching far backward. As usual, they are multicellular. Their ducts pierce the muscles and integument of the body wall to open on the sides of the body in enormous numbers. Farther back they are restricted to a narrow region in each section just lateral to the nerve cords, and open somewhat ventrally from the lateral edge. They continue in diminished numbers, but of large size, backward beyond the point where the esophagus opens into the intestine (pl. XII, fig. 3).

Alimentary canal.—A pair of remarkably narrow intestinal cæca reach forward well toward the brain. Their diameter for a long distance back is insignificant compared with that of the esophagus. They occupy positions ventro-laterally to the proboscis sheath and above the esophagus. Occasional pouches are sent off laterally into the tissues above the nerve cords. Farther back they become larger and extend laterally beyond the ventrally placed nerve cords. Towards the middle of the esophageal region the pouches become paired with considerable regularity. A well developed network of muscular fibers and connective tissue reaches between the pouches from the muscular layer above to that below the alimentary canal. The pouches lie close together still farther back, and near the posterior end of the esophageal region extend on each side below the esophagus and open together from opposite sides. The two intestinal cæca are thus connected together. From this point backward the esophagus decreases rapidly in size, the cæcum becomes large and is divided into numerous pouches by fibrous partitions extending between the muscular layers above and below, and eventually the esophagus opens into the intestine by a narrow slit in its dorsal wall (pl. XII, fig. 3).

Reproductive organs.—Far in front of the opening of the esophagus into the intestine the reproductive glands make their first appearance. The anterior pouches are scattered, and lie above the intestinal cæca well towards the sides of the body. These open directly on the dorso-lateral surfaces. Farther back similar ones appear below the intestinal canal, and these open ventrally (pl. XII, fig. 3). In the intestinal region the glands are very numerous and are scattered just inside the muscular layers all over the body—dorsally, ventrally and laterally. As many as 20 to 30 glands in a male are met with in a single section.

Their ducts lead directly to the surface of the body, and consequently open at any point instead of in certain definite regions as in many species.

Both lateral nerves and blood vessels join above the hind gut as in most other Nemerteans—the union of the nerves lying ventral to that of the blood vessels.

This species is named in honor of Prof. Dr. Otto Bürger, of Göttingen, whose monograph on the Nemerteans of the Gulf of Naples forms by far the most important contribution which has yet appeared relating to this group of worms.

Habitat.—Several individuals are often found knotted together in a seemingly inextricable mass. The body lies coiled in a mass, and is bent and folded in sharp angles.

The species was found under mussels on rocks between tides at Glacier Bay (W. E. Ritter) and at Sitka.

ZYGONEMERTES Montgomery.

Zool. Jahrb., x, p. 2, 1897.

A species of Nemertean was found at Sitka which agrees very closely with Verrill's description of *Amphiporus virescens*.¹ The detailed anatomical description given by Montgomery,² however, shows at once that the Alaska Nemertean is a distinct species. Montgomery has created a new genus for *A. virescens* Verrill based on its anatomical peculiarities, especially the structure of the proboscis and proboscis sheath. This genus he named *Zygonemertes*, with the following characters as its chief peculiarities:

(1) The proboscis sheath reaches to the end of the body, while (2) the thickened proboscis is but half as long; (3) basis of central stylet large, elongated; flattened or slightly concave posteriorly; (4) central stylet massive, not half the length of its basis; (5) ten or eleven proboscidial nerves; (6) body contractile, shape like *Amphiporus*, not as elongate as in *Emplectonema*; (7) ocelli numerous and small, extending along the nerve cords posterior to the brain.

While I am of the opinion that these characters are mainly of specific rather than of generic rank, yet I am convinced that because of the large number of species already in the genus *Amphiporus* the establishment of this new genus will be of great practical convenience. The most tangible characters of the group are: (1) the eyes extend posteriorly beyond the brain along the lateral nerve cords, and (2) the

¹Trans. Connecticut Acad., VIII, p. 20, 1892.

²Zool. Jahrb., x, p. 2 to 4, 12, 1897.

basis of the central stylet is massive and has a concave or a truncated posterior end, while the stylet itself is comparatively weak. Of course the number of nerves in the proboscis cannot be considered a generic character. There are two Alaska species, then, which may be placed in the genus—*Z. thalassina*, which is closely allied to the type species, and *Z. albida*, which is a minute, white form.

8. ZYGONEMERTES THALASSINA sp. nov.

Pl. II, fig. 5; Pl. VII, fig. 1; Pl. XIII, fig. 2.

Zygonemertes thalassina differs from *Z. virescens* chiefly in the following peculiarities: Color of former species much darker; eyes more numerous; shape of basis and central stylet of proboscis different; usually 5 stubby stylets in each lateral pouch, and 12 nerves in proboscis. There are minor differences in other anatomical details.

Zygonemertes thalassina has a slender, somewhat flattened body; head broad, not sharply marked off from body; one or two pairs of very inconspicuous oblique furrows on sides of head. The worms are active, and are restless in confinement.

Ocelli.—Ocelli very numerous; arranged in two or three longitudinal rows along sides of head, and extending backward along lateral nerve cords far behind brain. They are smaller posteriorly than in front and are more widely scattered. In front of the brain there are sometimes 40 or more ocelli arranged in two or three irregular rows (fig. 5) which follow the general outline of the lateral margin of the head. Immediately in front of the brain about a half dozen much smaller eyes are seen, and lateral to the brain are commonly 10 to 12 ocelli of moderate size. Behind these are usually 8 to 15 small ocelli scattered along the nerve cords at irregular intervals. These commonly reach nearly as far behind the brain as the distance from the brain to the tip of the snout in moderate extension. In sections (Pl. XIII, fig. 2) they are found to lie quite internal to the body musculature and almost directly upon the lateral nerves.

Size and color.—The specimens obtained were from 30 to 60 mm.

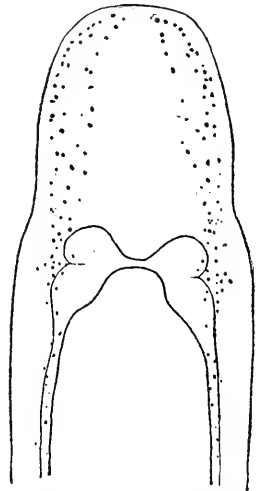


FIG. 5. *Zygonemertes thalassina*. Dorsal view of head showing outline of brain and lateral nerves, and arrangement of ocelli. $\times 12$.

in length in moderate extension, and rather slender. The color was olive-green both above and below. A coating of brown particles was sometimes scattered over the dorsal surface. The proboscis is pale.

Proboscis.—The proboscis sheath extends to posterior end of body; the proboscis extends only about half way to posterior extremity. The central stylet is remarkably short and blunt. Its basis (pl. vii, fig. 1) is at least twice, and often three times, as long as the stylet itself, and is massive in proportions. Its diameter is nearly constant throughout its length, although it is narrowed in front and constricted slightly at about three-fourths the distance towards its posterior end. The posterior extremity is sharply truncate or concave and often shows serrated edges (pl. vii, fig. 1). There are two lateral pouches of accessory stylets, and each usually contains five stylets similar in size and shape to the central stylet. The character of these remarkably stubby stylets is shown in pl. vii, figures 1a and 1b.

The lateral stylet pouches are imbedded in a thickened glandular wreath, yellowish in color, which lies around the circumference of the proboscis in front of the stylet. The mass of muscular tissue surrounding the basis of the central stylet is unusually thickened, and this necessitates an unusually long canal leading from the posterior chamber to the stylet region. In each of the two specimens sectioned the proboscis was provided with 12 nerves.

Cerebral sense organs.—Situated immediately in front of brain, but in the ventral portion of the head. The canals leading to the exterior pass obliquely forward and downward, and open on the antero-ventral surface near the tip of the snout.

Nephridia.—The nephridia extend from a point immediately in front of the brain backward throughout nearly the whole length of the esophageal region. There is a single pair of efferent ducts situated in the region of the brain, and opening to the exterior on the ventro-lateral aspects of the body. In the specimens examined one of these ducts lay as far forward as the ventral commissure of the brain, while the other was situated opposite the posterior end of the ventral brain-lobe.

Montgomery¹ mentions for *Z. virescens* that the superficial epithelium of the body contains numerous yellowish, sickle-shaped bodies situated among the epithelial cells. These also occur in *Z. thalassina*, but here they are of various sizes, and differ greatly in shape. Some are sickle-shaped, others are rod-like or irregular in form, and have every appearance of having been formed in the gland cells of the epithelium.

¹Zool. Jahrb., x, p. 2, 1897.

Somewhat similar bodies may be found in various other Metanemerteans, notably in *Amphiporus bimaculatus* and *A. leuciodus*. Here too they appear to originate as secretions in the glandular cells of the epithelium.

The lateral nerve cords unite above the posterior end of the alimentary canal as usual.

The tissues of the head in front of the brain contain large numbers of sub-muscular glands which open mainly on the anterior extremity, although a portion of them open directly outwards. These sub-muscular glands do not extend back into the esophageal region as they do in many other species.

The intestinal cæcum is paired from its origin. Its two branches extend forward on each side of the esophagus until they reach nearly to the brain. Here they bend dorsally (pl. XIII, fig. 2) and terminate by abutting closely against the posterior ends of the dorsal brain-lobes.

The ova are large and opaque. They appeared to be fully mature in June.

Habitat.—This species was found only at Sitka, where it was not uncommon among hydroids, broken shells, etc., in clear water.

9. ZYGONEMERTES ALBIDA sp. nov.

Pl. III, fig. 2; Pl. VIII, fig. 5.

This is a small, moderately slender species, very active in habits. It was met with only at Victoria, B. C., on the piles of a wharf. Sexually mature individuals were not more than 25 mm. in length. It was associated with *Amphiporus leuciodus*, which it somewhat resembles.

Color.—There are no markings on the body, the color being white with a tinge of yellow both above and below.

Ocelli.—This species may be easily recognized from other described forms by the arrangement of the eyes (fig. 6). These are scattered somewhat irregularly on the head in front of the brain, and extend backward as a single row on each side along the lateral nerves for about two-fifths the length of the esophageal region. The ocelli on the head are roughly arranged in two irregular rows on each side. There is an outer row

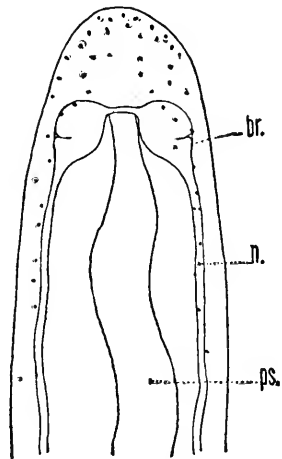


FIG. 6. *Zygonemertes albida*. Outline of anterior portion of body to show arrangement of ocelli. br, brain; n, lateral nerve; ps, proboscis sheath. $\times 12$.

of 9 to 12 eyes near each lateral border of the snout, and another row inside and somewhat posterior to the latter, containing about 6 small ocelli on each side, and of these 3 commonly lie nearly above the brain. Back of the brain 7 to 10 ocelli occur at widely separated intervals above the lateral nerve on each side.

Proboscis.—Proboscis comparatively large; central stylet moderately slender; basis dark, moderately elongated, of nearly uniform diameter throughout, and sharply truncated posteriorly (pl. VIII, fig. 5). Accessory stylet pouches two in number, each commonly containing two or three moderately slender stylets.

Cerebral sense organs.—Large, and situated immediately in front of brain.

The eggs of these worms are few in number, but are fully $\frac{1}{3}$ the diameter of the body in size; consequently there can be but a single row on each side. The sexual products are mature in June.

PARANEMERTES gen. nov.

Body of large size, rather stout, usually much rounded in the esophageal region but flattened posteriorly. Head not marked off from body, of variable form, in some states of contraction often emarginate in front. There is commonly a pair of inconspicuous oblique furrows back of head. The nerve cords and blood vessels join on the dorsal side of the posterior end of the intestine.

The mouth opens into the rhynchodæum. The proboscis sheath commonly reaches but little beyond the middle of the body—in *P. peregrina* to $\frac{3}{4}$ the distance towards the posterior extremity. The proboscis is small (*P. pallida*), of medium size (*P. peregrina*), or large (*P. carnea*). There is a single central stylet in the proboscis, and usually four or more pouches of accessory stylets. Some individuals of *P. peregrina*, however, have but two. Ocelli are numerous and minute. The cerebral sense organs are rather small and lie in front of the brain. Sub-muscular glands are usually well developed.

The species of this new genus show considerable resemblance to those of *Emplectonema* Stimpson. They differ, however, in general shape and appearance of body, never being very long or slender, and individuals do not coil their bodies into a mass as those of *Emplectonema* are so prone to do. The proboscis is much larger and the central stylet is always well developed. The proboscis sheath is also much longer. In many respects the genus resembles *Amphiporus*. The body is much longer, however, and not nearly so contractile, the proboscis is not nearly so large, and the proboscis sheath is not so long.

The armature of the proboscis resembles that in some species of *Amphiporus*.

Paranemertes is represented on the coast of Alaska by at least three species.

10. *PARANEMERTES PEREGRINA* sp. nov.

Pl. II, fig. 6; Pl. III, fig. 5; Pl. VII, fig. 7.

Body moderately elongated, flattened below, rounded on dorsal surface; anterior portion slightly more slender than middle region; posterior tapering gradually to extremity.

Head very variable in shape, commonly wider than the portion of body immediately following; flattened, sometimes sharply demarcated by lateral constrictions. Tip of snout pointed, rounded, or emarginate according to the state of contraction. On each side of the head is an inconspicuous V-shaped furrow, with the ends pointing obliquely forward above and below. The upper limb of the furrow reaches into the dark color of the dorsal surface, where it is sometimes conspicuous from its light color.

Color.—The color varies considerably as may be seen from a comparison of Pl. II, fig. 6, and Pl. III, fig. 5, but is commonly homogeneous dark brown, orange brown, or purplish brown above and on the sides, while the ventral surface is opaque white or whitish yellow. In most specimens the dark purple of the dorsal surface encroaches considerably on the ventral surface, shading gradually into whitish or yellowish. Seen from the ventral surface therefore the worms appear dull white or yellowish white, with a wide border of dark purple. Oftentimes the whitish color occupies scarcely more than the median third of the ventral surface. Anteriorly the whitish color covers the whole ventral surface, and on the head it covers also the sides and front. The head is dark purplish brown above, bordered in front and laterally by the light color of the ventral surface. At the posterior border of the head is a small angular spot on each side corresponding in color with that of the ventral surface. Behind the head is a narrow, V-shaped, dorsal marking, usually of lighter color, with its ends pointing forward and outward. In paler individuals the pinkish color of the brain lobes can be distinguished. The natural color of the body is well retained in formalin or alcohol.

Size.—Individuals of all sizes from 20 to 400 mm. were met with, but the most common size was about 150 mm. in extension. The width was commonly about 5 mm.

Ocelli.—Numerous minute eyes are arranged in two groups on each side (fig. 7). Of these, an anterior group of 12 or more small pigment spots are scattered along each side of the antero-lateral margin, while about as many more occupy an irregular cluster on each side just in front of the brain. These latter ocelli are usually well separated from the anterior, or marginal groups.

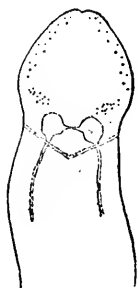


FIG. 7. *Parameletes peregrina* Outline of anterior portion of body to show the arrangement of ocelli. Dorsal surface. $\times 6$.

Proboscis.—Proboscis of medium size (as in *Amphiporus*), slightly yellowish, and usually everted when the animal is killed. The extruded proboscis is short and thick with an unusually slender posterior chamber. The armature (pl. vii, fig. 7) consists of a small, slender, sharply pointed central stylet, and with either 2 or 4 pouches of reserve stylets. The basis of the central stylet is very small and slightly enlarged posteriorly; the reserve stylets are slender and sharp like the central one, and commonly number from 6 to 10 in each pouch. When four pouches are present the number of stylets in each is as great as when there are only two pouches.

The mouth and proboscis open together, but the rhynchodæum is short. The proboscis sheath reaches about three-fourths the length of the body, or sometimes more than three-fourths. In each of four specimens sectioned there were 14 conspicuous nerves in the proboscis. The proboscis has a remarkably narrow ring of gland cells on the periphery near the posterior end of the basis of the central stylet.

A crowded mass of multicellular glands occupies the anterior portion of the head. The anterior ones open on the tip of the snout. In the brain region they open mostly on the lateral surfaces of the body, while farther back, and in the esophageal region, they assume the character of sub-muscular glands. No difference in appearance is noticeable between the cephalic glands and those in the esophageal region. They are present in the esophageal region only about as far back as the openings of the nephridia. Throughout their course they open to the exterior (by innumerable ducts which pass through the muscular and basement layers) on the ventro-lateral aspects of the body.

Alimentary canal.—A pair of slender branches of the intestinal cæcum reach forward nearly to the brain commissures and lie well above the lateral nerve cords. At about the point of the nephridial openings these branches pass ventrally and occupy a position beneath the esophagus. Another pair, coming forward from behind, take

their places. The ventral branches join to form the main median cæcum, from which short branches pass obliquely forward and dorsally at intervals. In cross section two pairs of branches are usually seen besides the main cæcum. One pair of these lies above and one below the lateral nerves. They are disposed in such a way that one pair ends at about the point where the second pair anteriorly originates. The branches are only irregularly arranged in pairs. The esophagus opens into the dorsal wall of the main cæcum.

Nephridia.—The nephridia occupy the anterior $\frac{2}{3}$ of the esophageal region. They are large, with numerous branches lying above the lateral nerves, and frequently passing internally to the nerves and beneath the esophagus. They reach forward nearly to the brain. At about $\frac{1}{3}$ of their distance posteriorly the main nephridial tubes, lying above the lateral nerves increase greatly in size and a pair of remarkably large efferent ducts pass externally to the lateral nerves to open on the lateral aspects of the body slightly below the lateral margins. The main duct reaching posteriorly from this point is larger than that in front.

Blood vessels.—There is a pair of large blood lacunæ in the head as usual; they join anteriorly by a broad anastomosis. The three longitudinal vessels are well developed to the end of the body where they anastomose above the anus. Sometimes the dorsal vessel lies beside or even above the proboscis sheath throughout a portion of its course, instead of below the sheath as usual.

Nervous system and sense organs.—The cerebral sense organs lie well in front of the brain, and external to the blood lacunæ. They open into a slight furrow on the lateral aspects of the head a little anterior to their own position. The lateral nerves form a commissure above the anus as usual.

Reproductive organs.—The sexual products were nearly mature in June and July. They are formed in numerous pouches which surround the intestinal canal on all sides. In a male as many as twenty sexual pouches were seen in a single section. They open directly to the exterior, whatever be their position.

Habitat.—This is a restless Nemertean, and on cloudy days was frequently met with crawling about over the stones on the beach between tides—which peculiarity has suggested its specific name. It was found abundantly at nearly all the collecting stations from Victoria, B. C., to Unalaska Island, and is one of the commonest Nemerteans of the coast. It occurs from low tide well up toward high water mark in every variety of location—under stones, among seaweeds, barnacles, mus-

sels, etc. The individuals are very voracious feeders, and were taken not infrequently with partially swallowed Chætopods. Their tenacity of life is remarkable—they will live for days in a small quantity of filthy water.

II. *PARANEMERTES PALLIDA* sp. nov.

Pl. VII, fig. 3; Pl. XII, fig. 1.

Body rather large, stout, rounded, and almost cylindrical anteriorly, somewhat flattened behind when extended; head variable in shape, not sharply marked off from portions immediately following, at certain states of contraction emarginate in front. A pair of inconspicuous oblique furrows back of head. When contracted the worms are nearly cylindrical and of about the same diameter throughout, except at the extremities, both of which are pointed.

Color.—The whole body, both above and below, is commonly uniform opaque white, sometimes showing traces of yellowish or reddish tints, especially in the anterior portions.

Ocelli.—Ocelli minute and numerous. In ordinary states of contraction they are arranged in a pair of elongated, irregular clusters on the antero-lateral margins of the head. The number of such ocelli is sometimes 30 or more in each of the two clusters.

Proboscis.—Small, short, and unusually slender (Pl. XII, fig. 1). Its armature consists of a moderately slender central stylet and usually 4 pouches of accessory stylets. The basis of the central stylet is moderately slender, slightly constricted near its middle portion, rounded behind, and of approximately equal length with the stylet (Pl. VII, fig. 3). There are commonly two accessory stylets in each of the 4 pouches. The chambers posterior to the stylet apparatus are remarkably narrow.

The mouth opens into the rhynchodæum. The proboscis sheath extends but little beyond the middle of the body, and sometimes not so far as the middle. One specimen had 9 nerves in the proboscis; another had 10. These nerves do not all enter the proboscis from the ventral side, as they do in *Amphiporus angulatus*, but those supplying the dorsal portion enter direct from that side.

Closely packed *sub-muscular glands* are present on the right and left sides of the body, and extend well inward towards the median line. Their ducts pierce the musculature and other layers of the body walls mainly on the latero-ventral aspects of the body. Twenty or more are frequently met with in a single section. These glands occupy also the region in front of the brain, and extend backward in decreasing

numbers to the commencement of the intestinal region. In front of the brain is a large and irregular cluster of glands, which open anteriorly on the tip of the snout.

Cerebral sense organs.—Situated in front of brain, and near latero-ventral margins of head. The ducts which place them in communication with the exterior run obliquely forward and downward, and open immediately on the surface.

Nephridia.—The nephridial canals extend from near the brain throughout almost the entire esophageal region. The main trunks lie above the lateral nerve cords, and send off numerous branches both ventral and dorsal to the nerves. There is a single pair of remarkably large efferent ducts opening just below the lateral margins of the body, and slightly anterior to the middle of the esophageal region. In one series of sections these ducts are so precisely paired that both appear in a single section (Pl. XII, fig. 1). The efferent ducts pass from above obliquely downwards and external to the nerve cords.

The blood-vascular system consists of cephalic lacunæ, and anastomosing longitudinal vessels, as in related genera.

The intestinal cæcum does not reach forward nearly to the brain. There are comparatively few lateral diverticula (Pl. XII, fig. 1).

The lateral nerve cords unite above the posterior end of the intestine.

Paranemertes pallida was found only at Yakutat and at Sand Point on Popof Island, and few specimens were obtained. These were about 150 mm. to 250 mm. in length, and perhaps 5 mm. in width. They were found between tides under stones covered with algæ.

12. *PARANEMERTES CARNEA* sp. nov.

Pl. III, figs. 3, 4; Pl. VII, fig. 4; Pl. VIII, fig. 7.

This species was found to be extremely variable in size, shape of body, and head, and especially in the armature of the proboscis. As shown in Pl. III, figs. 3 and 4, the body is rather stout, rounded in the esophageal region, flattened both above and below posteriorly, and ending rather abruptly behind. The head is very variable in shape, being pointed, rounded, broadened, or emarginate in front, according to its state of contraction. It is most commonly a little broader than the parts immediately following, and is not distinctly marked off, although a slight oblique furrow on each side is sometimes seen behind the brain. From the dorsal surface the furrows of the two sides give the appearance of a very faint V-shaped marking with the angle projecting backward in the median line. A little farther forward, as seen in Pl. VIII, fig. 7, a pair of shallow furrows occupies the sides of

the head. These are also V-shaped with the angle projecting backward on the lateral margins. The ventral limb of each V-shaped furrow reaches nearly to the opening of the rhynchodæum; on the dorsal surface the ends of the dorsal limbs are separated by about $\frac{1}{3}$ the diameter of the body in ordinary states of contraction (fig. 8).

In microscopic sections the V-shaped grooves on each side of the head are conspicuous, because of their differentiated epithelium. In these shallow depressions the epithelial cells are of smaller size, more slender in form, and seem to partake more of the nature of sensory cells. In these grooves the ordinary glandular cells are wanting. In the ventral limb of each V-shaped groove opens the tube which places the cerebral sense organs in communication with the exterior.

Ocelli.—There are commonly 20 to 32 eyes on the head arranged in 4 more or less distinct clusters, though their relative positions change with the contraction of the head. The two anterior clusters contain about 4 to 6 eyes each, and occupy the antero-lateral margins of the head (figs. 8, 9). The posterior clusters lie directly back of these,

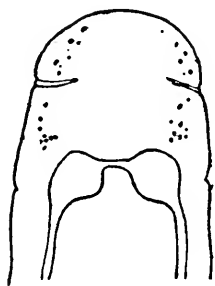


FIG. 8.

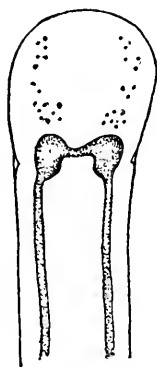


FIG. 9.

FIGS. 8 and 9. *Paranemertes carnea*. 8. Outline of head from dorsal surface showing arrangement of ocelli. The two pairs of lateral indentations indicate the lateral and dorsal furrows. $\times 8$. 9. Outline of the head when extended. Dorsal surface, showing arrangement of ocelli. $\times 6$.

and immediately in front of the brain. Each of these clusters contains 8 to 12 scattered ocelli. An individual from Taku Harbor had 6 ocelli in each anterior cluster, and 10 in each posterior one. Another specimen had only 3 or 4 eyes in each of the four clusters, but in this case the ocelli were larger. A specimen from Popof Island had 3 large eyes in each anterior, and 6 to 8 in each posterior cluster; one from Virgin Bay had 6 in each anterior, and 7 in each of the others,

and had 3 single eyes between the anterior and posterior clusters, while one from Yakutat had 3 large ocelli in a row on the anterior margin of the head, and a pair of scattered clusters of 8 to 12 eyes each in front of the brain. When the head is contracted so that it is emarginate in front, the arrangement of the eyes into clusters disappears, and they are then all scattered irregularly on the antero-lateral margins. Figs. 8 and 9 show the general arrangement of the eyes.

Color.—The whole body, both above and below, is a homogeneous, very pale red or flesh-color (pl. III, figs. 3, 4), and is entirely without markings except for a longitudinal median line of deeper red, showing the position of the proboscis sheath, and the deeper color of the intestinal lobes. In some specimens the reddish color was more pronounced anteriorly, and some were very pale. The intestinal lobes are seen through the clear tissues of the body walls as narrow, transverse markings, slightly darker than the rest of the body. The reddish color of the brain and lateral nerves is often conspicuous from the dorsal surface (pl. III, fig. 3).

Size.—Individuals were seen which were 500 mm. long in greatest extension, although the majority were less than half this length.

Proboscis.—Mouth and proboscis open together through a subterminal pore. The proboscis is large (pl. VIII, fig. 7) and of moderate length. The short proboscis sheath does not reach far beyond the middle of the body. The armature of the proboscis shows marked variations. The size and shape of the central stylet and its basis, however, remain fairly constant. The central stylet is of the regular *Amphiporus* type, is moderately slender, and rests on a moderately slender basis. The basis is slightly narrower in front and is rounded behind (pl. VII, fig. 4). The number of pouches of accessory stylets is commonly from 6 to 12. One specimen had 12 of these pouches, each with one or two slender stylets; each of two others had six pouches with two stylets in each pouch. Three specimens had each twelve nerves in the proboscis, while a fourth specimen had but eleven.

Cerebral sense-organs.—Unusually small and situated some distance in front of brain-lobes. They occupy positions very close to the ventro-lateral borders of the head, and beneath the cephalic blood lacunæ.

Nephridia profusely branched, and extending throughout the greater portion of esophageal region, though they do not reach the brain. Their numerous branches ramify both above and below the lateral nerve-cords, and several efferent ducts of small size lead to the exterior from both the dorsal and ventral branches. There may be about five

pairs of efferent ducts, all of which open in the immediate vicinity of the lateral nerves. In one series of sections a small efferent duct from one of the branches above the lateral nerve was followed only two sections farther back by a similar, though larger, duct from a branch below the lateral nerve on the same side. The nephridia end posteriorly near the point where the esophagus opens into the intestine.

Sub-muscular glands of limited number lie between the musculature and the intestine and proboscis sheath. These glands are closely packed together in the head in front of the brain; back of this point they become widely scattered, although they do not cease entirely until back of the esophageal region.

A short intestinal cæcum with a few wide lateral diverticula extends forward beneath the esophagus. This cæcum is shorter than in most species of the genus, and does not reach nearly to the brain. The esophagus also is short and opens directly into the dorsal wall of the intestine.

A pair of large blood lacunæ occupies the anterior portion of the head as usual.

The lateral nerves and longitudinal blood vessels join above the posterior end of the alimentary canal, as in most species.

Reproductive glands in both male and female are very numerous, and are situated both above and below the intestine. They open directly to the surface, as could be determined from their rudimentary ducts, although the sexual products were very immature in June and July.

Habitat.—This species is conspicuous because of its clear, rosy or flesh-like color, which is all the more striking in contrast with the black mud in which it is usually found. It occurs between tides in muddy locations over a large portion of the southern Alaska coast. It was collected at Taku Harbor, Sitka, Yakutat, Prince William Sound, and Popof Island, although only a few were found at each locality. Usually but one or two specimens were found in several hours' digging.

AMPHIPORUS Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This is by far the most common genus on the Alaska coast, and to it belong six of the thirty species of Nemerteans collected.

The genus *Amphiporus* includes mostly rather stout, solid, often flattened forms, usually of considerable size, which are capable of an almost incredible amount of extension and contraction. A few forms, however, are long and cylindrical, even when contracted, but others

can contract until the body becomes almost barrel-shaped. The worms can neither swim nor roll up spirally.

Proboscis.—Provided with a single, well-developed central stylet, with a cartridge-shaped basis, and with two or more pouches of accessory stylets. The proboscis sheath usually reaches nearly or quite to the end of the body.

Ocelli.—Usually present in very considerable numbers. A few forms are without eyes, and a few others have but a single pair—there are never 4. The eyes do not extend far behind the brain.

Cerebral sense organs.—Usually well developed. Their position is most commonly in front of the brain, but they are sometimes beside or even behind the ganglia.

13. AMPHIPORUS ANGULATUS (Fabr.) Verrill.

Pl. VI, fig. 4; Pl. VII, figs. 2, 2a; Pl. XI, fig. 2; Pl. XIII, fig. 3.

Fasciola angulata O. FABRICIUS, Müller's Verm. Terrest. et Fluv., I, p. 58, 1774.

Onatoplia stimpsonii GIRARD, in Stimpson, Invert. of Grand Manan, Smithsonian Contributions to Knowledge, p. 28, 1853.

Nareda superba (?) GIRARD, loc. cit.

Cosmoc phila beringiana STIMPSON, Proc. Acad. Nat. Sci. Philadelphia, p. 165, 1857.

Amphiporus angulatus (FABR.) VERRILL, Marine Nemerteans of New England, Trans. Conn. Acad., p. 10, 1892.

"This large and conspicuous species is generally easily recognized by its clear dark purplish or chocolate-brown color above, with pale margins and a trapezoidal or triangular white spot on each side of the head and usually with a narrow white line across the neck; and by the pinkish or flesh-colored lower surface. Ocelli in two or more rows in an elongated groove on each antero-lateral margin of the head, and a pair of small sub-dorsal clusters on the transverse white nuchal band." (Verrill, loc. cit.) The arrangement of the eyes and markings on the head of the Alaska specimens are shown in fig. 10 and in Pl. VI, fig. 4. In ordinary state of contraction the body is rather short and stout. When disturbed it can become so greatly thick-

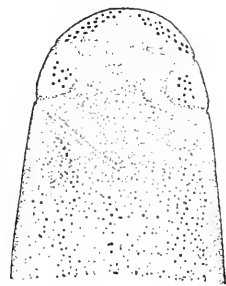


FIG. 10. *Amphiporus angulatus*. Dorsal view of anterior portion of body showing markings on the head and the arrangement of ocelli. $\times 8$.

ened anteriorly that its transverse diameter is fully $\frac{1}{3}$ as great as its length. In extension the body is but moderately elongated, and is relatively broad and flat. It contracts very much as does a leech.

The Alaska specimens are commonly larger than have been recorded elsewhere, often measuring 200 mm. or more in length and 10 mm. in width.

Proboscis.—The proboscis is large, thick, and pale reddish or salmon in color. The smallest specimen collected had 17 nerves in the proboscis; four other specimens examined had each 18 proboscidial nerves, one had 19 nerves, and two others had 20 each.¹ This shows more strikingly than has previously been pointed out that the number of nerves in the proboscis is variable to a very considerable extent. Bürger² has shown that *Drepanoporus crassus* may have 19 or 20 nerves, and *D. spectabilis* 24 or 26. Nevertheless in the other Alaska species the number has been found surprisingly constant. The number of nerves in any particular proboscis remains perfectly constant so far as I have observed from the anterior end back as far as the stylet region. Here they break up into a plexus and lose their identity. The nerves in *A. angulatus* enter the proboscis at its anterior attachment and in its ventral portion (pl. XI, fig. 2). They then divide into their definite number of branches (usually 18) which pass obliquely dorsally and arrange themselves symmetrically on the periphery. The proboscis sheath extends within a few sections of the posterior end of the body.

The armature of the proboscis is made up of a moderately slender central stylet, and (usually) two pouches of accessory stylets. The basis of the central stylet is about as long as the stylet itself. It is moderately slender, constricted near its middle (pl. VII, figs. 2, 2a), enlarged and rounded posteriorly. Each reserve pouch commonly contains 5 to 7 rather slender stylets, similar in size and shape to the central stylet.

Ocelli.—Numerous and characteristic in arrangement. The dark pigment on the head, however, often renders them difficult of accurate determination. Girard³ states for *Omatoplea stimpsonii* that there are six or more minute eyes "situated in an oblique, simple row, on either side of the head anteriorly." The same author (loc. cit.) describes

¹Of eight specimens of this species from Eastport, Maine, one had but 17 nerves in the proboscis, six had 18 each, and one had 19 or 20. Other anatomical details in the eastern form agree perfectly with those of specimens from Alaska. I have recently examined a number from the original locality of Stimpson's *C. beringiana* (Bering Strait), and have no doubt as to the specific identity of this form with that from southern Alaska and from Eastport, Maine.

²Fauna u. Flora des Golfes von Neapel. Monogr. 22, Nemertinen, p. 372, 1895.

³Marine Invert. Grand Manan, Smithsonian Contr. to Knowledge, p. 28, 1853.

Nareda superba as having but a single pair of rounded ocelli situated wide apart on the transverse white band of the neck. It seems highly probable, as Verrill suggests,¹ that both of the species are identical; in the one case only the marginal eyes were seen, while in the other the cerebral clusters were supposed to represent single eyes and the marginal ones were overlooked. Verrill¹ describes the eyes correctly, and his diagnosis of the species is so full and accurate that it is necessary to describe here the internal anatomy only. A pair of elongated clusters of ocelli lies on the antero-lateral margins of the head, and another smaller cluster on, or near, the angular white spot on each side of the head. As shown in fig. 10, each of the anterior clusters may contain upwards of 20 ocelli arranged in two or more irregular rows nearly parallel with the antero-lateral margin of the head, while the posterior groups may consist of 8 to 15 similar ocelli. The posterior groups are situated deep in the tissues of the head. Of course the number of ocelli varies greatly in different individuals.

Cerebral sense organs.—Well developed. They lie a little in front of the brain, beside the esophagus, and below the cephalic blood lacunæ. Each *sense organ* has a wide canal which leads a short distance anteriorly and opens to the exterior on the latero-ventral aspect of the body. The brain itself is of large size, with a thick ventral and narrow dorsal commissure (pl. xi, fig. 2).

Nephridia.—The nephridia extend from near the brain (pl. xi, fig. 2) well backward in the esophageal region. In one specimen there were two pairs of efferent ducts opening on the latero-ventral aspect of the body; in another only one pair.

Cephalic glands.—The cephalic glands open on the tip of the snout and are well developed. Sub-muscular glands, likewise, are remarkably abundant. They reach from the brain region well back towards the end of the esophagus. They are multicellular, each one being composed of upwards of a score of large, vacuolated cells with small nuclei situated on the side farthest from the lumen. Each gland has a twisted duct leading through the muscular layers, basement membrane, and integument, and opening to the exterior on the ventro-lateral aspects of the body (pl. xi, fig. 2).

Beneath the esophagus a broad cæcal appendage of the intestine stretches forward well toward the brain region. This cæcum consists of a large median canal with pouch-like diverticula extending dorsally above the lateral nerve cords.

There is the usual anastomosis of the three longitudinal vessels, and

¹Marine Nemerteans of New England, Trans. Conn. Acad., viii, p. 12, 1892.

of the pair of lateral nerve cords (Pl. XIII, fig. 3), above the hind gut and slightly in front of the anus. As seen from the figure, the union of the blood vessels is directly dorsal to that of the nerve cords.

The reproductive glands occur both above and below the alimentary canal. Sexual products were not nearly mature in June and July.

Habitat.—The species is extremely abundant along the whole Alaska coast as far west as Unalaska Island, and Stimpson records it from Bering Strait. It is found under stones between tides in all sorts of situations. Stimpson's specimens came from a depth of five fathoms. The species is found on the Atlantic coast of North America from Massachusetts Bay to Greenland (Verrill, *loc. cit.*).

14. AMPHIPORUS BIMACULATUS.

Pl. I, fig. 4; Pl. V, fig. 10; Pl. VIII, fig. 2; Pl. XII, fig. 2.

Body rather short, broad, and flattened both above and below. Head narrower than parts immediately following. Body of about the same width and thickness throughout esophageal and intestinal regions. Posterior extremity tapers rather abruptly to the pointed or rounded end. Opening of rhynchodæum situated on subterminal portion of snout. From near this opening a pair of slits pass obliquely backward and upward behind the eyes to the brain region.

Color.—The color of this species is very striking. The whole dorsal surface back of the head is deep brownish orange, somewhat paler behind. The head is without color, or of a very much paler color than the rest of the dorsal surface, and in the center of this pale area two oval, black or very dark brown spots lie side by side. These are very characteristic, and are conspicuous even in alcoholic specimens. The black spots sometimes occupy a considerable portion of the pale area, and are sometimes sharply angular in front (Pl. I, fig. 4). In the median line of the body the color is slightly paler than elsewhere and in the center of this paler stripe is a dark, but inconspicuous, longitudinal line. The pale stripe and dark line both fade out at a point about $\frac{1}{6}$ the distance towards the posterior end of the body. The brain lobes appear as pinkish bodies just posterior to the black cephalic spots. The whole ventral surface is of a homogeneous, pale orange or flesh color, with the exception of pinkish spots marking the position of the brain, and a slightly paler stripe below the anterior portion of the proboscis sheath.

Ocelli.—The eyes are rather large, and number 25 to 30 or upwards on each side (fig. 11). The majority lie in an irregular marginal row beside and in front of each of the black cephalic spots. At

the posterior end of each marginal cluster the ocelli are more closely and more irregularly placed, and often occupy several rows. In addition to these marginal clusters a closely set group of about a half dozen smaller ocelli is situated in the light area lateral to the posterior end of each of the dark cephalic spots. These ocelli lie deeper in the tissues of the head, and near the brain (pl. 1, fig. 4).

Proboscis.—The proboscis is remarkably large, and its constituent layers are very sharply defined (pl. XII, fig. 2). The proboscis sheath has a correspondingly massive development, and reaches to the very extremity of the body. The stylet apparatus of the proboscis is very characteristic of the species, because of the extreme minuteness of the basis of the central stylet. The central stylet itself is very long and slender, while the length of its basis is but half as great. The basis is constricted in the middle, and is $\frac{2}{3}$ as wide as long (pl. VIII, fig. 2). There are usually four pouches of accessory stylets. These pouches are not evenly distributed on the circumference, for two lie close together on one side of the proboscis, the other two on the opposite side. There are usually five to seven slender stylets in each of the four pouches.



FIG. 11. *Amphiporus bimaculatus*. Outline of head to show position of markings and arrangement of ocelli. $\times 8$.

Most of the stylets are much smaller than the central stylet. Measurements of the stylets of one individual about 100 mm. long are: central stylet .12 mm. long, .015 mm. wide near base; basis of central stylet, .06 mm. long, .04 mm. wide; largest accessory stylet, less than .1 mm. long. The proboscis is provided with 16 large nerves (pl. XII, fig. 2).

The mouth and proboscis open together. There are three large communicating blood lacunæ in the head, one on the right, one on the left, and one dorsal to the rhynchodæum.

Cerebral sense organs.—Remarkable for their large size, being fully as large as either of the brain lobes. They lie lateral to the brain, slightly *behind* the commissures, and in the angle between the dorsal and ventral lobes. A large process from the posterior end of the dorsal lobe furnishes the sense organs of the same side with an abundant innervation. Their posterior ends extend backwards beyond the dorsal brain lobes, against the posterior faces of which they are closely pressed. Behind the dorsal brain lobe the sense organs lie directly dorsal to the lateral nerve-cords and are bathed on their internal borders by large blood lacunæ. A section through this point is not very different from a corresponding section of a *Heteronemer-*

tean. Of the Alaska Metanemerteans here recorded this is the only one in which the cerebral sense organs lie posterior to the brain commissures. The canal by which each sense organ communicates with the exterior is of large size, runs anteriorly in front of the brain, and opens on the ventro-lateral aspect of the head.

Nephridia.—The nephridia reach forward close to the posterior ends of the cerebral sense organs. Anteriorly there is a tangle of small vessels, but farther back these unite into a single large, branched canal which runs close beside the blood vessels above the lateral nerve on each side. From these canals a pair of large efferent ducts pass above the lateral nerve cord, and open to the exterior of the body just below the lateral margin.

Sub-muscular glands.—Present along anterior portion of esophageal region, but not very abundant.

A broad and profusely branched *intestinal cæcum* runs forward from the intestine well toward the brain region. The cæcum lies well beneath the esophagus and sends off numerous pouch-like branches dorsally above the lateral nerve cords.

Reproductive glands.—These occur both above and below the intestinal canal. Although the sexual products were very immature in one of the specimens sectioned, yet the efferent ducts of the glands were formed as far outward as the basement layer of the cutis. Here each duct ended in a swollen chamber lined with cylindrical epithelial cells.

Size.—The individuals of this species varied from 40 to 150 mm. in length. The largest were about 6 mm. wide and 2 mm. thick.

Habitat.—The species was collected at Victoria, B. C., on the piles of the wharf; at Sitka among hydroids, etc., near low water (W. E. Ritter), and a finely preserved specimen from Puget Sound, State of Washington, was given me by Prof. Trevor Kincaid.

15. AMPHIPORUS TIGRINUS sp. nov.

Pl. IV, figs. 5-8; Pl. VIII, fig. 4; Pl. X, figs. 3, 4.

Body moderately slender, rounded throughout, head not marked off from parts immediately following, rather narrow and pointed in front; posterior extremity of body narrow. On each side of the head is a shallow, inconspicuous, oblique groove.

Color.—In June, at the time the specimens were collected, the sexual products were fully mature, and the species showed marked sexual color varieties. The prevailing color of the females was yellowish orange both above and below, but except in the esophageal region, this color was to a great extent obscured by the dark olive green

color of the mature ova. These ova developed in large pouches on each side of the body, and each pouch with its contents appeared as a dark green spot. In many cases several adjacent pouches lie nearly in contact, giving the external appearance of dark green blotches. Seen directly from the dorsal surface the green spots appear on each side in more or less regular pairs, those of the two sides being separated by an interrupted, narrow, longitudinal, median band of yellow. From the sides the ovaries appear as irregular transverse stripes of dark green alternating with the yellow color of the body—hence the specific name, *tigrinus*. The males are much less deeply colored. They are pale yellowish with a slight tinge of green, and the spermaries appear as innumerable cream-colored specks. Both males and females have a narrow, longitudinal, median band of brownish on the anterior dorsal portion of the body. After preservation in alcohol both sexes assume a greenish color, which is retained even after mounting in balsam.

Ocelli.—The eyes are numerous, and are arranged in two irregular, and scarcely separated, clusters on each side of the head in front of the brain. The individual ocelli are so irregular in shape, so variable in size, and so closely massed together, that it is difficult to determine their precise number. Many of them appear as ragged pigment masses. Commonly, however, there are a dozen or more of such ocelli in each of the anterior clusters, and perhaps 8 to 10 in each of the posterior ones. The ocelli of the anterior clusters are scattered through the tissues of the head from the dorsal to the ventral surface. Some of the ocelli are three times as large as are others. In contraction all the eyes of the same side form a single confused cluster. Because of their variability of position no drawing is given of their arrangement.

Proboscis.—The long and well developed proboscis is provided with a remarkably weak armature. This consists of a small central stylet and two pouches of accessory stylets. The central stylet is small and short, but is acutely pointed. Its massive basis, double the length of the central stylet itself, is short, thickened, and rounded behind (pl. VIII, fig. 4). In a worm 75 mm. long, the central stylet measured about .075 mm. in length; the basis was .15 mm. long and .075 mm. in average diameter. The accessory stylets are, like the central stylet, short, broad at the base, but sharply pointed. They usually number about five to each pouch. The glandular wreath about the stylet is well developed, and in the specimens examined is deep green in color even after mounting in balsam. The proboscis sheath reaches nearly to the posterior end of the body.

Cerebral sense organs.—Smaller than in most species of the genus. They are situated slightly in front of the brain, but are well separated from it because they lie near the ventro-lateral border of the head. The canals placing them in communication with the exterior are, consequently, extremely short. Each canal opens into the shallow, oblique furrow on the side of the head. The posterior ends of the sense organs lie beneath the anterior borders of the ganglia, but much nearer the ventral surface. A pair of large nerves given off from the dorsal ganglia opposite their commissure connect with the sense organs. The lateral nerve cords unite above the posterior end of the intestine as usual.

The body cavity in the esophageal region is filled with an unusually large amount of gelatinous tissue, which occupies the considerable space between the muscular layers and the esophagus and proboscis sheath (pl. x, fig. 4). In this gelatinous tissue the lateral nerves are situated, and through it a complex system of blood vessels and nephridial canals ramifies.

The intestinal cæcum is very broad and has but short lateral diverticula. It lies wholly beneath the esophagus, and the branches do not extend above the lateral nerves. The cæcum ends anteriorly far behind the brain region. The esophagus becomes very small before it empties into the dorsal wall of the broad intestine.

The attachment of the proboscis to the tissues of the head, the position of the rhynchodæum and its openings into the esophagus and proboscoidal cavity, the position of the dorsal and ventral brain commissures, the cephalic glands and other organs are shown in pl. x, fig. 4.

The sexual products are mature in June. The whole body becomes distended with the pouches of sexual elements, and the cavity of the alimentary canal is much reduced in consequence. The ova are large and deep olive-green.

The length of the specimens obtained, both males and females, was about 75 to 100 mm. in extension.

Habitat.—This species was met with only at Farragut Bay, where it occurred under stones in muddy locations at about half tide.

16. AMPHIPORUS NEBULOSUS sp. nov.

Pl. IV, fig. 1; Pl. VIII, fig. 6; Pl. XI, fig. 1.

Body short, rather broad, and much flattened; narrower anteriorly than in the intestinal region, and tapering gradually posteriorly. Mouth sub-terminal; head pointed or expanded in front, according to

state of contraction. A V-shaped furrow is present on each side of the head near the tip; the angles of these furrows point obliquely forward above and below.

Color.—Dull white or pale yellowish on dorsal surface; very thickly mottled with confluent dark brown blotches and dots which largely obscure the ground color. Margins of the head without spots. There are faint indications of a pair of transverse lines without color—one near the tip of the snout and the other near the brain region, the latter sometimes becoming a shallow, irregular, V-shaped furrow. Ventral surface dull white or yellowish, without markings other than deeper yellow spots which indicate the positions of the genital sacs, and the darker color of the intestinal canal.

Ocelli.—On each side of the head are from 18 to 25 ocelli, arranged in three irregular groups (fig. 12). Close to the anterior border of the snout are 4 or 5 large cup-shaped ocelli on each side. Behind these and bordering each lateral margin are about 8 much smaller eyes in an irregular group, while 3 or 4 small eyes are scattered between these and the anterior group. Behind each lateral group, and not far in front of the brain, about 7 to 10 small ocelli lie in an irregular cluster deeper in the substance of the head, and are therefore less easily visible.



FIG. 12. *Amphiporus nebulosus*. Outline of the head to show arrangement of ocelli. Dorsal surface. $\times 7$.

Size.—The specimens obtained measured 100 to 150 mm. in length, and 5 mm. in width. The esophageal region is short, rounded above, flattened below, and thicker than the intestinal region.

Proboscis.—The proboscis sheath reaches nearly to the extreme end of the body. Proboscis thick, fairly large, and white. It is provided with 17 nerves. Basis of central stylet very much broadened posteriorly (pl. VIII, fig. 6), flat or even emarginate behind, narrow in front. Central stylet as long as the basis, slender, acutely pointed. Accessory stylets in two pouches; similar to central stylet, but sometimes very slightly curved; commonly 3 in each pouch. The pouches lie well behind the central stylet in ordinary extension (pl. VIII, fig. 6). Wreath of gland-cells surrounding basis of central stylet moderately broad.

In the brain region (pl. XI, fig. 1) and for some distance posteriorly an abundance of large multicellular glands are thickly placed in the ventro-lateral aspects of the body, and are mostly situated among the fibers of the longitudinal muscular layer. Behind the brain these sub-muscular glands become so closely packed together that the muscular

layer is divided into an outer and an inner portion in the region where the glands are situated. The ducts from the glands (pl. XI, fig. 1, *smg*) pass through the muscular layers and basement membrane to open to the exterior among the epithelial cells of the integument. These glands become smaller and more scattered near the region of the nephridial openings, but do not disappear entirely until near the end of the esophageal region.

Alimentary canal.—The mouth and proboscis open together into the rather long rhynchodæum. The esophagus is as usual in the genus. A single pair of small intestinal cæca reach forward well toward the brain region. They lie immediately below the esophagus, and near the middle line. Farther back they join a median, broad, unpaired cæcum. This has wide, paired, lateral outgrowths which, still farther back, alternate with clusters of reproductive glands. These lateral appendages of the cæcum lie mostly above the reproductive glands, as well as alternate with them. Much farther back the esophagus decreases greatly in size and opens into the intestine by a longitudinal slit in the dorsal wall of the latter. The intestinal pouches are rather deep; the anus is subterminal.

Nephridia.—The nephridial canals reach anteriorly nearly to the region of the brain, where there is a single branched longitudinal vessel on each side. Throughout the greater part of its length, this main canal lies above the lateral nerve cord, but sometimes lies internal to it or above it. In the anterior third of the esophageal region the main canal becomes very large; here an efferent duct branches off, passes outside the lateral nerve, and bends downward to open on the exterior of the body on the ventro-lateral aspect. There is but one efferent duct on each side, and the two are sometimes exactly paired. Back of the efferent ducts, the nephridial canals decrease rapidly in size, and disappear far in front of the anterior end of the intestinal region.

A pair of large blood lacunæ lie in the anterior portion of the head as usual. In the brain region they divide into numerous smaller vessels (pl. XI, fig. 1). The lateral vessels form a broad anastomosis with the dorsal vessel above the anus.

Nervous system and sense organs.—The dorsal ganglia are closely fused with the ventral. They are without distinct posterior lobes, and sink gradually into the ventral ganglia (pl. XI, fig. 1). The cerebral sense organs are well developed. They lie in front of the brain, some distance ventrally from the dorsal ganglia, and communicate with the exterior by a canal which opens ventro-laterally. Each sense organ is lobulated posteriorly and provided with a large nerve (*son*,

pl. xi, fig. 1) which arises from the ventral side of the dorsal ganglion near the ventral commissure. The union of the lateral nerve cords above the anus lies in the same section as the anastomosis of the three longitudinal blood vessels. A pair of small nerves from the lateral cords continues backward beyond the commissure to the end of the body.

Reproductive organs.—The sexual glands first make their appearance in the esophageal region at the point where the unpaired intestinal cæcum receives its pair of anterior branches. Those sexual glands which are situated most anteriorly lie below the alimentary canal, internal to the lateral nerves, and open on the ventral surface of the body. Farther back are commonly four or five reproductive pouches in a single section. These lie mainly below the intestine, but no matter what their position they all open to the surface of the body *below* the lateral margins. Those lying farthest from the middle line and above the lateral nerves open ventrally between the nerve cords and the lateral margins. Sexual products appear to be fully mature in July.

Habitat.—Beneath stones near low water at Kukak Bay, Alaska Peninsula (T. Kincaid).

17. AMPHIPORUS LEUCIODUS sp. nov.

Pl. vii, fig. 6.

Body usually not more than 50 to 75 mm. in length, slender, elongated, flattened posteriorly, not capable of great contraction. Head narrower than parts immediately following. An inconspicuous V-shaped furrow on dorsal surface back of head, seen only under favorable conditions.

This species resembles young individuals of *A. exilis*, with which it is often associated. It is likewise similar in many respects to *A. lactifloreus* (Johnston) McIntosh, from which it differs widely in the armature of the proboscis and in many other anatomical features.

Color.—Opaque white, sometimes with a pale reddish or yellowish tinge. This color is commonly uniform throughout, though it is somewhat influenced by the internal organs which show through the body walls. The brain is pinkish, the intestine often brownish.

Ocelli.—There are four irregular, but usually distinct groups of minute ocelli on the anterior portion of the head. Bordering each antero-lateral margin of the tip of the snout is an elongated cluster of about 8 to 12 ocelli (fig. 13). Posterior to these marginal clusters,

and somewhat nearer the median line is a pair of clusters, each of which likewise contains 8 to 12 ocelli. These posterior groups lie immediately above the brain. Smaller and evidently younger individuals have but 4 to 6 eyes in each of the four groups. There is considerable variation in the size of the ocelli.

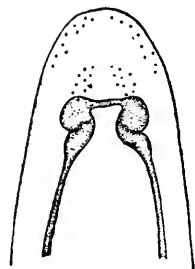


FIG. 13. *Amphiporus leuciodus*. Outline of anterior portion of the body showing brain and arrangement of the ocelli. $\times 12$.

Proboscis.—The proboscis sheath reaches nearly to the posterior end of the body. The proboscis is rather slender but may be contracted so that its diameter is equal to more than half that of the body itself. The proboscis is commonly attached to the proboscis sheath at a point situated from $\frac{1}{3}$ to $\frac{1}{4}$ the distance towards the posterior end of the body. The armature is weaker than in *A. exilis*. The central stylet is moderately slender and acutely pointed. Its basis is somewhat conical in shape, contracted slightly toward its middle portion (pl. VII, fig. 6), and is rounded at its larger, posterior end. It is slightly longer than the stylet itself. The number of pouches of accessory stylets is commonly three, although there are sometimes only two, and occasionally a specimen is found which has four. There are usually two or three stylets in each pouch. In a few instances, however, four and five were observed. Where three pouches are present, as is usual, they are situated at nearly equal distances on the circumference of the proboscis (pl. VII, fig. 6).

Cerebral sense organs.—Moderately small and situated well in front of brain and on ventral side of head. They communicate with the exterior by means of a pair of canals which open on the latero-ventral margins of the tip of the head.

Nephridia.—The nephridia reach forward to the brain region. There are several pairs of efferent ducts, some of which open on the ventral, and some on the dorsal surface of the body. In one of the specimens sectioned the first pair of efferent ducts extended from the internal side of the lateral nerve cords and opened directly to the latero-ventral aspect of the body after passing on the *ventral* side of the nerve cords. A little farther back in the esophageal region were two efferent ducts on one side and one on the other which passed above, and externally to the nerve cords to open likewise below the lateral margins. In the remainder of the esophageal region were three more efferent ducts on each side. With one exception all of these passed above the lateral nerves and opened on the dorso-lateral surfaces of the

body as in *A. exilis*. Another specimen had 7 efferent ducts on the left side and 8 on the right. Of those opening on the left side the four anterior ones passed dorsally to the nerve cord and then bent ventrally to open on the ventro-lateral aspect of the body; the fifth one opened very near the lateral margin, and the last two opened on the dorso-lateral surface. On the right side the four anterior ducts opened ventro-laterally, and the four posterior ones opened on the dorso-lateral surface. The nephridia extend backward beyond the first few pairs of reproductive glands. Here, then, we find the connecting links between the typical *Amphiporus* nephridium (which passes above and external to the lateral nerve and then bends downward to open on the ventro-lateral aspect of the body), and the type of nephridium which is characteristic of *A. exilis* and the Heteronemerteans, and which opens directly on the dorso-lateral aspect of the body.

Sub-muscular glands are closely packed together in front of the brain and in the brain region. They are not found farther posteriorly, and in this respect the species differs markedly from *A. exilis*.

The *intestinal cæcum* reaches forward well toward the anterior end of the esophageal region. The main cæcal cavity, which lies directly beneath the esophagus, sends off numerous lateral pouches above the lateral nerves, and at its anterior end branches into lateral diverticula which extend forward on each side as far as the brain region.

Reproductive glands.—The genital products mature in June in the region of Victoria, B. C. The ova develop in sacs which are regularly arranged, and extend from the posterior third of the esophageal region to the posterior end of the body. The ovaries, in all cases noticed, were situated immediately above the lateral nerves. In the intestinal region they alternate with the intestinal lobes with a great deal of regularity. Their efferent ducts occupy positions on the latero-dorsal aspects of the body exactly corresponding to those of the posterior efferent nephridial ducts. The ducts from the ovaries, however, pierced only the longitudinal muscular layer, and did not penetrate the circular muscular layer of the body wall. These rudimentary genital ducts are further distinguished from the nephridial ducts by lacking a conspicuous epithelial lining.

Habitat.—These slender whitish worms were found in great abundance beneath barnacles and other growths on the piles of the wharf at Victoria, B. C. They were found less abundantly under stones between tides at New Metlakahla and in Glacier Bay, but were not noticed farther northwest.

18. AMPHIPORUS EXILIS sp. nov.

Pl. III, fig. 1; Pl. VII, fig. 5; Pl. XI, fig. 3.

Body extremely elongated for the genus, rounded throughout; not capable of the great contraction which characterizes many species of the genus; only moderately flattened; posterior extremity slender. Head usually narrower than esophageal region. The general shape of the body resembles that of *Emplectonema*. In shape of body, as well as in color and habits, this species, like the last, recalls *A. lactiflorens* (Johnston) McIntosh. Its anatomical structures are, however, very different, as will be seen from the following description.

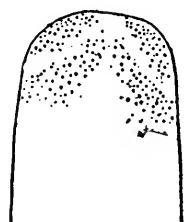


FIG. 14. *Amphiporus exilis*. Dorsal view of head to show arrangement of ocelli. $\times 8$.

Ocelli.—Exceedingly numerous and minute. They are arranged on the head in four elongated clusters (fig. 14). Two of these clusters lie on each antero-lateral margin of the head, while the two other groups lie more posteriorly (just in front of the brain), and extend from near the middle line obliquely outward and backward. Sometimes the two posterior clusters are united in front into a continuous V-shaped group. The number and distribution of these eyes is indicated by the following table, which shows the numbers found in ten individuals:

	No. of ocelli in anterior clusters.		No. in posterior clusters.	
	Right.	Left.	Right.	Left.
1.	12	11	15	17
2.	16	17	26	28
3.	18	19	33	30
4.	23	23	32	31
5.	25	24	40	42
6.	25	26	52	46
7.	28	26	45	46
8.	35	37	54	45
9.	35	35	51	53
10.	60	56	71	73

In the specimens examined, therefore, the number of ocelli in the front clusters varied from 11 to 60, that in the posterior clusters from 15 to 73. The average in the 10 individuals is about 28 in each anterior cluster, and 41 in each posterior group.

All the ocelli are minute, but nevertheless very irregular in size, some being several times as large as others. From the ventral surface the anterior marginal clusters only are seen.

Proboscis.—The proboscis sheath is long and slender. Even in this elongated species it reaches within a few millimeters of the posterior end of the body. The proboscis also is slender, though of moderately large size. It reaches well backward in the body. The armature of the proboscis is especially remarkable. The central stylet is moderately slender, rather small, and rests on a moderately heavy basis. The basis is somewhat conical in form, and rounded posteriorly (Pl. VII, fig. 5). In addition to the central stylet there are usually 8 pouches of accessory stylets (Pl. VII, fig. 5), though the number varies from 6 to 12. In each pouch are one or two slender stylets. Often there is a single fully developed stylet, and a second, immature stylet in most of the pouches. The proboscis is usually extruded when the animal is killed.

Cerebral sense organs.—Situated far in front of brain—nearly at end of snout when the head is contracted—and fairly well developed. Their canals open on antero-lateral borders of tip of snout.

The blood-vascular system resembles that in other species of the genus.

Nephridia.—The nephridial system shows peculiar deviations from the arrangement usually found in the Metanemerteans. A pair of main canals with numerous branches runs longitudinally above the lateral nerve cords, as in other species. These reach forward well toward the brain and extend posteriorly far into the intestinal region. Their branches ramify both above and below the lateral nerve cords. The number and position of the efferent ducts is remarkable—there are commonly 20 or more on each side. The first is near the anterior end of the main nephridial canal, and sometimes opens on the ventro-lateral aspect of the body, as in other species of the genus. Back of this, however, were counted nine other efferent ducts on each side in the esophageal region, and at least as many more were present on each side in the intestinal region. These ducts were mostly small and opened on the *dorsal* aspect of the body, as in many Heteronemerteans. The positions of the efferent ducts were sometimes immediately above the lateral nerves, and sometimes but a little laterally from the proboscis sheath. Most commonly, however, the ducts occupied positions between these two extremes, so that the majority of the nephridiopores were situated on the dorsal surface about half way between the lateral margin and the median line (Pl. XI, fig. 3). As noted on page 52, an approach to this condition is found in *A. leuciodus*. These appear to be the only species of the genus, and indeed the only Metanemerteans, in which the nephridiopores are situated on the dorsal surface of the body.

The *intestinal cæcum* is enormously developed. Its diverticula reach forward on each side even to the anterior end of the brain. In the brain region each of the cæcal diverticula appears as a rounded lobe on either side directly above, and closely approximating to, the dorsal brain-lobe. Back of the brain there are several rather slender lobes on each side. These lie mainly above the lateral nerves, but send off branches below the nerves at frequent intervals. Somewhat farther back in the esophageal region these lateral lobes join the main, unpaired cæcum, which lies immediately below the esophagus. This cæcum, throughout its course to the intestine proper, gives off numerous lateral diverticula on each side, and these branch upward above the lateral nerve cords (pl. XI, fig. 3).

Sub-muscular glands.—These occur abundantly in the brain region, and are still more closely packed together in the anterior portion of the esophageal region. They occupy positions, as in other species, in the connective tissues beneath the musculature in the latero-ventral regions of the body. Each gland is composed of a number of cells, and each has a duct leading through the layers of the body wall to the exterior on the latero-ventral aspect. A much smaller number open on the dorsal surface. In the posterior end of the esophageal region these glands have almost entirely disappeared, although a few are met with in the anterior portion of the intestinal region.

Color.—The color of the individuals of this species is commonly a homogeneous, opaque white, very pale flesh color, or pale yellowish-white. This color is continuous throughout the length of the body, both above and below, except where the internal organs show through. The smaller specimens are pale, while the larger ones almost always exhibit a brownish color, which indicates the position of the intestine. Sometimes minute reddish-brown specks are distributed over the dorsal surface. Occasionally a worm of this species is met with in which the intestinal lobes are pale orange. The brain is plainly distinguishable in the living worm because of its pinkish coloration.

Habitat.—*Amphiporus exilis* is one of the most common, as well as the most widely distributed species of nemerteans met with on the expedition. It occurred abundantly at nearly all the collecting stations from Victoria, B. C., to Dutch Harbor, Unalaska. The worms are restless and are often seen crawling over stones between tides. They live among barnacles, mussels, etc., from low water well up to high water mark, and are found abundantly under stones in almost all sorts of locations. The species is especially hardy.

TETRASTEMMA Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This genus includes a group of very small, slender worms, seldom more than 20 to 30 mm. long, with slightly flattened body, and usually with four well-developed ocelli, which form a quadrangle on the head. In a few species (cf. *T. aberrans*) these ocelli are each replaced by a group of two or three smaller ones, and in other species ocelli are wanting entirely. The anatomical structures are very similar to those of *Amphiporus*, and the distinctions between the two genera are not clearly defined. The mouth and proboscis open together. The cerebral sense organs lie close in front of the brain. The proboscis sheath extends to the posterior end of the body, and the proboscis is well developed, armed with central stylet and pouches with accessory stylets, and usually provided with ten nerves.

Only three species of the genus were met with on the expedition, although it seems probable that a number of other forms of these minute worms will be found later.

19. TETRASTEMMA BICOLOR sp. nov.

Pl. I, fig. 6.

Body moderately slender, rounded both above and below; much larger and longer than most species of the genus, sometimes becoming 50 to 60 mm. in length in extension.

Color.—This species is bright brownish-red or orange the whole length of the dorsal surface; the whole ventral surface is pale gray or whitish. The anterior border and lateral margins of the head, as well as the lateral margins of the body for a short distance back of the head, have the same whitish color as the ventral surface. A narrow, median, white stripe, sharply marked off from the reddish color of the dorsal surface, extends from the white, anterior border of the head nearly to the posterior end of the body. Posteriorly the stripe becomes more irregular and is usually lost near the posterior extremity.

Ocelli.—Four, rather large, rounded, arranged nearly in the form of a square.

Proboscis.—Proboscis sheath and proboscis as in typical species of the genus. Proboscis provided with a moderately heavy central stylet about .075 mm. in length. Basis of central stylet somewhat conical in shape, swollen behind, and about $1\frac{1}{2}$ times as long as the stylet itself. There are two pouches of accessory stylets, with usually three or four stylets in each pouch.

The blood is dark red, and the blood vessels may be traced in the living worm the whole length of the body.

Habitat.—The species was found only at Kadiak, where it was dredged in about three fathoms. It slightly resembles some varieties of *T. vermiculus* Quatrefages, but the longitudinal bands of dark pigment between the two ocelli of the same side are lacking, and the median white line is sharply demarkated, so that the two species are undoubtedly specifically distinct.

20. TETRASTEMMA ABERRANS sp. nov.

This is a minute Nemertean, the specimens found not exceeding 12 mm. in length in greatest extension. Body moderately slender, slightly flattened. A pair of slight vertical slits on sides of head.

Color.—Pale yellow throughout, both above and below.

Ocelli.—Of moderate size, or rather small, arranged in four groups which form a rectangle, as do the single eyes of typical species of the genus. Each of the four groups is composed of three to five ocelli of variable size. The two anterior groups lie well toward the tip of the snout, while the two posterior groups lie above or slightly in front of

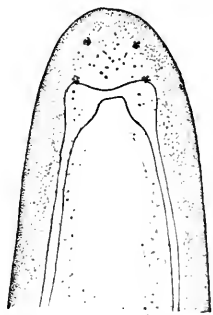


FIG. 15. *Tetrastemma aberrans*. Dorsal view of anterior portion of body, showing outline of brain and arrangement of the four groups of ocelli. $\times 25$.

the brain (fig. 15). The appearance of the eyes is such as to give at once an impression that the multiple nature of each group has arisen from the fragmentation of single ocelli. This I consider to be the case. At least one other species of *Tetrastemma* (*T. cruciatum* Bürger) is known in which the four ocelli are double, and I have often noticed other species of the genus—notably the fresh water *T. rubrum* (Leidy)—which showed almost conclusively that one or more of the six or seven eyes present had been derived from a splitting of the primary ocelli. In one instance the fragmentation had been carried so far that no fewer than 20 to 30 pigment spots were present.

Proboscis sheath and proboscis as in other species of the genus. Mouth and proboscis open together; proboscis sheath reaches the posterior end of the body. Proboscis provided with a rather slender central stylet and basis; the two accessory stylet pouches each with two or three stylets of typical form. The proboscis possesses twelve nerves, and in this respect again shows a departure from the typical *Tetrastemma*, where there are usually but ten proboscidial nerves.

Nephridia.—The nephridial canals are short, and reach forward to the brain. Anteriorly each nephridium lies above the lateral nerve, but farther back the branches ramify both above and below the nerve. Near the anterior end of each of the main canals a large efferent duct passes outside of the lateral nerve, and bends downward and outward to open to the exterior on the lateral margin of the body. In one instance a double efferent canal was observed.

The head is provided with large cephalic glands which open on the tip of the snout. The *cerebral sense organs* are large. They lie mainly in front of the brain, although their posterior ends extend backward beside and lateral to the brain lobes. Each connects with the exterior by a canal which runs anteriorly to open on the lateral margin of the head.

A broad *intestinal cæcum* reaches into the anterior fourth of the esophageal region. It lies below the esophagus, and sends off a few wide lobes on each side, but these reach dorsally only a little above the lateral nerve. The esophagus opens into the cæcum far behind the anterior sexual glands, and nearly as far back as the middle of the body. The reproductive pouches lie both above and below the intestine.

As will be seen from the above description, this species agrees closely with the typical species of *Tetrastemma* in size, general appearance, and in the details of the internal anatomy. It differs from known species of the genus only in the fragmented nature of its eyes and in the number of nerves in the proboscis. It seems extremely probable, however, that when more of the described species have been examined in this regard, some of them will be found to contain more or less than ten proboscicidal nerves. The eyes certainly resemble those of *Tetrastemma* more closely than they do those of any described species of *Amphiporus*.

Habitat.—Found among hydroids in about four fathoms in Glacier Bay, and between tides at Orca, Prince William Sound. Not common.

21. TETRASTEMMA CÆCUM sp. nov.

A small species which I shall refer provisionally to this genus was found by Ritter in considerable numbers at Kadiak. The species is especially remarkable, and quite aberrant from most other species of *Tetrastemma*, both in lacking ocelli and in being hermaphroditic. The body is rounded and of almost even diameter throughout. The head has a pair of inconspicuous, oblique, lateral furrows.

Color.—The worms are very pale, whitish or pale yellowish in color, with dark intestinal lobes.

Size.—Very small, not usually more than 5 to 10 mm. long and 0.5 to 1 mm. in diameter when sexually mature.

Ocelli.—Wanting.

Proboscis.—The proboscis sheath reaches nearly to the end of the body. The proboscis is remarkable for its enormous size as compared with the size of the body—when everted its diameter is practically equal to that of the body itself, although it is then comparatively short. Its armature consists of a central stylet with rather slender basis, and of two pouches of accessory stylets. The basis of the central stylet is slightly swollen and somewhat sharply truncated posteriorly. Each pouch contains 2 or 3 long, slender and delicate accessory stylets.

In cross section of the proboscis the inner and outer circular muscular layers appear as usual. The intervening layer of longitudinal muscles, however, is divided into two secondary layers separated by a thick sheet of nerves and connective tissue. The nerves appear to be more or less confluent, and not separated into a definite number of longitudinal cords as in most other species of *Tetrastemma*. This appearance may be partially due, however, to the action of the formalin in which the worms were preserved.

Sense Organs.—The cerebral sense organs are very well developed, and unusually voluminous as compared with the other organs of the head. They lie in front of the brain, and extend posteriorly on the ventral side of the brain lobes as far as the ventral commissure. Each sense organ communicates with the exterior by a small canal passing obliquely forward to open on the lateral margin of the head.

The *brain* is of small diameter, but its extent antero-posteriorly is comparatively great.

Reproductive organs.—The individuals are hermaphroditic, and probably to some extent protandric although there is considerable variation in this respect. One of the individuals sectioned was filled with ripe spermaries only, but all the others possessed enormous ova, with the spermaries disposed irregularly. The mature ova were fully two-thirds the diameter of the body, and hence were arranged at irregular intervals in a single row. Where the ova were mature the spermaries were smaller and contained much fewer spermatozoa than in those individuals which were without large ova. Many of the spermaries had ducts which pierced the muscular layers to reach the dorso-lateral surfaces of the body. In some cases where these ducts were fully formed, and the spermatozoa therefore mature, the ova in the same individual were but half grown. The sexual products were mature in July.

TÆNIOSOMA Stimpson.

Tæniosoma STIMPSON, "Proc. Acad. Nat. Sci. Philadelphia, p. 162, 1857.

Polia DELLE CHIAJE, Mem. sulla storia e notomia degli anamali senza vertebre del regno di Napoli, Naples, 1823-28.

Eupolia HUBRECHT, Report of Challenger Exped. Zool., XIX, 1887.

Eupolia BÜRGER, Fauna u. Flora von Neapel, Monogr. 22, p. 598, 1895.

For the reasons given on page 4, it seems absolutely necessary to adopt for this genus the name given by Stimpson in 1857 rather than accept that of Hubrecht of 30 years later, even though most European writers have ignored Stimpson's brief, but careful, diagnoses.

The species belonging to this genus show a remarkable specific variation in the general shape and size of the body. Some are characterized by extremely long, slender, flattened, and much twisted bodies, while others are short, thick, and cylindrical. In all the species, however, the head in life is rounded in front and is sharply marked off from the parts immediately following by lateral constrictions. Horizontal furrows are wanting, but small, oblique or transverse grooves may be present on the head. In strong contraction the esophageal region becomes greatly swollen, the head is drawn in (Pl. II, fig. 4), so that the anterior end of the body is large and shortly truncated.

Proboscis sheath and proboscis short, seldom reaching more than one-third the length of body. Proboscis opening subterminal, minute. Mouth a small round opening on the ventral surface immediately behind the ganglia.

Muscular layers of body composed of a thick outer longitudinal, a circular, and a less thickened inner longitudinal layer. Outside the muscular layers is a well developed cutis, composed of a thick inner layer of connective tissue, and an outer layer of glandular tissue. The external epithelium is thin, as compared with the other layers of the body, though the fibrous layer separating it from the cutis is well developed. The musculature of the proboscis consists of an inner longitudinal, and an outer circular muscular layer. Consequently there can be no muscular crosses.

The cephalic glands are enormously developed. They stretch backward on all sides beyond the brain, and even reach some distance into the esophageal region.

The lateral nerves lie immediately outside the circular muscular layer. There are three longitudinal blood vessels.

Ocelli are usually present in great numbers, though very small.

The worms are sluggish in their habits, are unable to swim, and usually show great irregularities in the diameter of the body. They

are prone to twist themselves in sharp coils, or in knots, and often lie in lumps. They are usually capable of contracting and extending their bodies to a remarkable degree.

22. *TÆNIOSOMA PRINCEPS* sp. nov.

Pl. II, figs. 3, 4.

Body of very large size, long, thick, largest in the esophageal region, cylindrical in anterior portion, flattened on ventral surface posteriorly; in contraction nearly cylindrical throughout. Head sharply marked off from body in extension, rounded in front, flattened dorso-ventrally; in contraction drawn almost entirely into the parts immediately following, so that the anterior portion of the body is greatly swollen and sharply truncated in front. In contraction the anterior end of the body is thrown into massive folds, and the whole body is remarkably short and thick (Pl. II, fig. 4). A pair of inconspicuous, oblique grooves lies on the antero-ventral surfaces of the head; into these the canals leading from the cerebral sense organs open. The esophageal region is scarcely more than one-twelfth the length of the body. In alcoholic specimens there is usually a median ridge on the dorsal surface running the length of the body, except in the head and esophageal regions.

Color.—The dorsal surface is deep ochre yellow, sometimes inclining to orange, and sometimes to brownish, and thickly strewn with minute irregular dark red spots. The reddish markings are most conspicuous near the anterior end of the body, and in the dorsal, median line. In many places a large number of the reddish dots become confluent, and form an irregular patch of deeper color. These patches commonly occur as broken longitudinal lines. Such lines are most abundant on the middle of the dorsal surface where they form a median longitudinal band of reddish-brown. The ventral surface is paler and the reddish markings are wanting. Along the median line the color is brighter yellow than elsewhere on the ventral surface. This is apparently due to the absence in this position of the opaque intestinal lobes. The ventral surface often exhibits a greenish tinge to the yellow ground color. The posterior extremity is pointed and much paler than the rest of the body.

Size.—*T. princeps* grows to a size greater than has previously been described for any species of the genus. The individuals found were from half a meter to two meters in length when extended; when contracted, but a small fraction of this length, and proportionately thick (Pl. II, fig. 4). After long standing in alcohol a section of the

body of one specimen still measured 15×18 mm. It is one of the largest Nemerteans of the coast.

Ocelli.—There are many minute ocelli arranged in an irregular group on each side of the tip of the head. The number of such ocelli is commonly 40 or more in each of the two groups.

The *mouth* is a small rounded pore, and is situated several millimeters back from the tip of the head in large individuals. The proboscis-pore is also minute, and is situated subterminally as usual.

Proboscis.—The proboscis sheath reaches some distance into the esophageal region, but is very short when compared with the length of the body. The proboscis is short and weak. Its muscular and epithelial layers are as in other species of the genus.

The *cephalic glands* are enormously developed. They occupy a large proportion of the area in the anterior portion of the head, surround the brain on all sides, and extend still further backwards into the anterior end of the esophageal region. Here they lie in the outer longitudinal muscular layer around the whole circumference of the body.

Body walls.—The outer longitudinal muscular layer about equals in thickness the other two muscular layers combined. In the intestinal region the inner longitudinal muscular layer becomes extremely thin on the lateral aspects of the body, and is much reduced dorsally. It is only on the ventral side that this layer retains its comparative thickness. The cutis is thinner than in most species of the genus, and especially is this true of its inner, fibrous layer. This layer is, throughout most of the body, reduced nearly to the condition of a thin membrane. It is commonly not much thicker than the muscular layer beneath the body epithelium. The epithelium itself is thin in comparison with the massive muscular layers of the body.

The *blood lacunæ* in the head lie directly above the brain, as in other species of the genus. They are, however, remarkably large, and are crossed in various directions by numerous bundles of muscular tissue, which tend to subdivide the lacunæ into numerous smaller spaces. The longitudinal blood vessels are as usual. The dorsal vessel passes out of the proboscis sheath early in its course.

Nephridia.—Situated in anterior and middle portions of esophageal region. Several efferent ducts on each side. These are small in diameter and pass above the nerve cords, opening on the lateral aspects of the body dorsal to the lateral margins.

Cerebral sense organs.—The dorsal lobes of the brain greatly exceed the ventral lobes in size, and lie somewhat lateral as well as above them. The cerebral sense organs are voluminous. They extend for-

ward on each side, external and ventral to the dorsal brain lobes, nearly as far as the ventral commissure. Here, at the anterior extremity of each sense organ, a canal passes obliquely downward and outward to open into a shallow oblique furrow on the ventro-lateral aspect of the head. The sense organs are closely united with the posterior ends of the dorsal brain lobes. In the middle region of the brain, the anterior ends of sense organs are triangular in section, and lie external and between the dorsal and ventral ganglia. Farther back a glandular appendage of the sense organ pushes itself in between the internal faces of the brain lobes. This appendage fuses with the ventral portion of the sense organ more posteriorly. The brain lies deeply buried in the tissues of the head and nearly in the median line, but the lateral nerves while still in the region of the cephalic sense organs bend sharply outward, and occupy throughout the remainder of their course positions immediately external to the circular muscular layer of the body wall.

The *genital products* were nearly mature in July. The oviducts were in many instances preformed, and opened on the dorso-lateral aspects of the body.

Habitat.—Only four individuals of this species came under my observation. One was collected at Cape Fox (Kincaid), two at Yakutat, and the fourth at Orca in Prince William Sound. All were found under stones in rather hard mud at low water. The individuals contract strongly when handled, throwing the surface of the body into wrinkles, and often coil the posterior portion of the body into a close spiral, much as does *Cephalothrix*.

LINEUS Sowerby.

The British Miscellany, London, p. 15, 1806.

Representatives of this genus are characterized by a slender, sometimes thread-like body, usually rounded throughout. The body is commonly twisted and coiled into an irregular mass. The movements are sluggish. The animals creep over objects and readily move about on the surface of the water, but they are unable to swim. The body is extremely contractile; the head is often slightly wider than the body, of oval shape, and is usually provided with numerous minute ocelli, often arranged in a single row on each side of the head. A caudal papilla or cirrus, a diagonal muscular layer, and neurochord cells are all wanting. The proboscis sheath is often short in comparison with the length of the body.

23. *LINEUS VIRIDIS* (Fabr.) Johnston.

Planaria viridis O. FABRICIUS in O. F. Müller, Zool. Dan. Prod., 1776; Fauna Grœnlandica, p. 324, 1780.

Planaria gesserensis MÜLLER, Zool. Danica, II, p. 32, 1788.

Nemertes obscura DESOR, Boston Journ. Nat. Hist., VI, pp. 1 to 12, 1848.

Lineus viridis JOHNSTON, Catalogue British Non-parasitical Worms, pp. 27, 296, London, 1865.

As stated by Verrill,¹ there seems little doubt that the description of this species sent by Fabricius to Müller and published by him in the *Zoologica Danica*, is entitled to retain priority in nomenclature instead of Müller's *gesserensis* of later date, which has been adopted by most recent European writers.

Characteristic individuals of this species were found under stones at low water at New Metlakahtla, on Annette Island.

Body moderately slender, rounded throughout, but slightly flattened posteriorly; head slightly wider than the parts immediately following; cephalic slits long and deep, with pale margins above and below, reaching anteriorly close to the proboscis pore. The anterior end of the mouth does not reach quite so far forward as the posterior end of the cephalic slits. Length usually 100 to 200 mm.

On each side of the head in front of the brain and close to the lateral borders is a single row of minute ocelli (fig. 16). The number of these is commonly from four to six on each side, though some individuals have as many as eight, and very young specimens but a single pair.

Color.—The Alaska specimens were dusky or brownish green, becoming dark brown anteriorly, and commonly paler on the ventral surface, especially posteriorly. The head is very pale on lateral margins and in front. The brain is large, reddish, and shows distinctly through the pigment of the body. Cerebral sense organs paler but easily distinguished in life, with conspicuous canals leading to the posterior ends of the cephalic slits (fig. 16).

Habitat.—This species, besides being found in Alaska, is widely distributed in northern waters. On the east coast of America it occurs from Long Island Sound to Greenland. It is found on nearly all the coasts of northern Europe. It has also been found in the Medi-

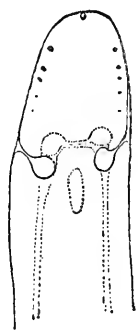


FIG. 16. Outline of anterior portion of body of *Lineus viridis* showing arrangement of the ocelli, and position of brain, cephalic sense organs and mouth. $\times 8$.

¹Trans. Connecticut Acad., VIII, p. 421, 1892.

Proc. Wash. Acad. Sci., March, 1901.

terranean, though it is there comparatively rare and small. It is usually found between tides under stones in muddy localities.

24. *LINEUS TORQUATUS* sp. nov.

Pl. v, figs. 8, 9.

Body rather thick and stout for the genus, somewhat flattened throughout, but especially posteriorly and on the ventral surface. Head short, pointed in front, somewhat narrowed behind, slightly flattened. A slight annular constriction commonly marks off the head region from that immediately following. Sometimes this constriction is very conspicuous, and the head much narrower behind. Esophageal region rounded above, flattened below. Intestinal region commonly well flattened but without narrow margins. Posterior end slender.

Cephalic furrows rather short. In alcohol or formalin they join the terminal proboscis pore in front, but in life they are separated from it.

Ocelli.—Absent, at least in mature individuals. Mouth a minute pore or a large slit, according to state of contraction; situated a little behind posterior end of cephalic furrows.

Color.—The color is usually dark, reddish-brown, chocolate, or purple above; paler and commonly more reddish beneath. The dorsal surface is often flecked with irregular minute, inconspicuous whitish specks. A narrow transverse white band passes across the dorsal surface at the posterior ends of the cephalic furrows. This characteristic marking reaches only to the lateral edges, and is not seen from the ventral surface. The cephalic furrows are sometimes, but not always, bordered above and below by a narrow band of white. Furthermore a minute white spot occupies the region of the proboscis pore. The white borders of the cephalic furrows commonly connect this white spot with the white transverse dorsal band on the posterior portion of the head. On the extreme tip of the snout—in the white area around the proboscis pore—a pair of small pigment spots is sometimes present, one on each side of the proboscis pore.

Size.—Length usually 200 to 400 mm. in extension, width about 5 mm.

Proboscis.—The proboscis is moderately slender and of medium size. It is without color. The inner longitudinal muscular layer is almost entirely wanting; the crosses between the circular layers are distinct, and the nervous plexus is exceptionally well developed. A single pair of large nerves enters the proboscis at its point of attachment at its anterior end. They originate from the ventral commissure of the brain near the ventral ganglia, enter the proboscis from the ven-

tral side, pass backward for some distance on the right and left sides respectively, and later spread out into a cylindrical plexus immediately internal to the muscular layer, and separated from the inner epithelium only by a few longitudinal muscular and connective tissue fibers.

Glands.—The cephalic glands are very well developed, and occupy a large portion of the region of the head in front of the brain, both above and below the rhynchodæum. They do not extend posteriorly quite so far as the brain.

Nerves.—The nervous system is far more easily made out than in any of the related species with which I am acquainted. The individual nerves are large and are sharply defined in all cases. The nerves extending from the brain toward the tip of the snout are numerous and are all of large size. The esophageal nerves are also surprisingly large and quite conspicuous. They have several transverse connecting branches after their origin from the ventral ganglia. The most posterior of these connecting branches occurs just in front of the mouth. In the mouth region they communicate in several instances with the lateral nerves by means of branches which pass through the nervous plexus outside the circular muscular layer. These branches from the lateral nerves follow the nervous plexus to the vicinity of the esophageal nerves, which they join by passing directly through the circular muscular layer. I do not know that such an anastomosis between the lateral nerve cords and the esophageal nerves has been previously noted in any species.

The median dorsal nerve, situated just outside the circular muscular layer, is unusually conspicuous, and throughout a considerable portion of the intestinal region is supplemented by a second median nerve lying directly beneath the first, but in the midst of the internal longitudinal muscular layer. Branches connect these two nerves at frequent intervals.

Cerebral sense organs.—Voluminous. The canals leading to the exterior open on the summit of a broad papilla situated at the posterior, widened end of each of the cephalic slits.

Nephridia.—The nephridial canals are of much greater diameter than I have observed in any other Nemertean. The canal on either side is, throughout a portion of its length, equal to the lateral nerve cord in cross section. The nephridia extend through the anterior half of the esophageal region. The main tubule has a few very large branches, and these lie in the walls of the blood spaces about the esophagus. Anteriorly the branches lie mainly dorsal to the lateral nerves, but towards the posterior ends of the nephridia the branches

ramify more towards the ventral side of the esophagus. There is a single pair of efferent ducts which are of enormous size as compared with those of other species. These ducts are situated at about two-thirds the distance towards the posterior ends of the nephridia, and open on the dorso-lateral aspects of the body as usual.

Habitat.—This species is common in mud and under stones in muddy localities at Orca and Virgin Bay in Prince William Sound, but was not met with elsewhere on the expedition. The individuals are hardy and of sluggish movements. They do not break up nor contract excessively when thrown into killing fluid, and the proboscis is not usually everted when the animal is killed. Some, especially the smaller ones, when preserved are nearly cylindrical, but most individuals are flattened ventrally. The color is fairly permanent in formalin, and even in alcohol for some months.

MICRURA Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This genus includes mostly moderately small, slender forms, generally less rounded posteriorly, and of rather more active habits than *Lineus*. Its most marked distinction from the latter genus is that the posterior extremity of the body is provided with a slender, usually colorless, muscular caudal cirrus. This is formed of a continuation of the muscular tissues and integument beyond the posterior end of the alimentary canal.

The species of *Micrura* are generally, though not always, more brightly colored and have more distinct markings than those of *Lineus*. The vast majority of the species are provided with numerous ocelli, though some are blind. The head is slender, and not distinctly separated from the rest of the body. The lateral faces of the body are not provided with thin edges as in *Cerebratulus*, the intestinal region is not so much flattened, neurochord cells are not present in those species which have been studied, and none of the species are able to swim as do all species of *Cerebratulus*. The mouth is usually smaller than in *Cerebratulus*, and the intestinal lobes are not so deep.

The proboscis is usually slender and comparatively weak; the proboscis sheath is sometimes considerably shorter than the body.

25. MICRURA VERRILLI sp. nov.

Pl. v, figs. 1, 2, 3.

Body moderately elongated, widest anteriorly, tapering to an acute anterior extremity; much more slender posteriorly. Ventral surface

flattened; dorsal surface rounded. Head narrow in front. Cephalic furrows long and deep; at their posterior ends each is met by an oblique, shallow depression above and below. Proboscis-pore exactly terminal; anterior ends of cephalic furrows well separated from proboscis pore. Mouth small, situated as far back as posterior ends of cephalic furrows. Caudal cirrus small, slender, easily broken off.

Color.—This is one of the handsomest and most striking of all the described species of Nemerteans. The color of the dorsal surface is deep purple or wine-color; that of the ventral surface is purest white.

On the dorsal surface are usually 15 to 40 very sharp, pure white, transverse bands or lines connecting with the white color of the ventral surface. These transverse bands are nearly as narrow as pencil marks, and are situated at fairly regular intervals throughout the length of the body. They are sometimes more or less interrupted, but always sharp and distinct. On the dorsal surface of the tip of the snout is a small triangular marking, always very conspicuous because of its bright orange color. Following behind this is a narrow transverse white band, followed by broad purple and narrow white bands in succession. The cephalic furrows lie within the white color of the ventral surface, and are bordered above with a very narrow margin of white. They reach posteriorly as far as the second white band.

After preservation in formalin or alcohol the worms are strongly rounded below as well as above, and the color of the dorsal surface changes from purple to red, while the orange spot on the tip of the snout disappears.

Ocelli.—None were found.

Proboscis.—Colorless, and shorter than in many species of the genus. Its microscopic structure shows distinctly the three muscular layers and the muscular crosses characteristic of the family. The inner circular muscular layer is very thin. The nervous plexus inside the circular layer is usually well developed.

Nervous system.—The dorsal ganglion of the brain is divided posteriorly into two distinct lobes, of which the smaller, dorsal lobe ends shortly, while the larger, ventral lobe continues into the cerebral sense organ. Each of these sense organs is of about the same size as one of the ventral ganglia, but considerably smaller than either dorsal ganglion. The duct lying on the external border of each of the pair of cerebral sense organs communicates, as usual, with the enlarged posterior end of the cephalic furrow by means of a wide duct opening directly outwards. The dorsal median nerve, lying just outside the circular muscular layer, is remarkably conspicuous throughout the whole length of the body.

A section through the esophageal region shows that the outer longitudinal muscular layer of the body wall is particularly thick, and that the esophagus is unusually small. The other layers are as in most species of the genus.

The lateral blood lacunæ break up in the esophageal region into numerous thin-walled vessels, or spaces, which surround the lateral and ventral walls of the esophagus.

Nephridia.—The nephridia extend through the anterior $\frac{2}{3}$ of the esophageal region, as a single profusely branched tubule on each side. All the branches of the main canal are small, and lie in close connection with the walls of the blood spaces about the esophagus. The efferent ducts are very numerous, but minute. They open on the dorso-lateral aspects of the body, usually not far above the lateral margins. In a single instance one of the efferent ducts was found to open beneath the lateral margin, but this must be looked upon as abnormal. In several instances two efferent ducts lay close together on the same side, but in such cases one originated much nearer the ventral side of the esophagus than did the other. The actual number of efferent ducts counted in one medium-sized individual was 17 on one side, and 24 on the other.

Reproductive organs.—The pouches containing the sexual products when mature become so voluminous as to occupy more than half the entire space within the body walls. In July, when the genital products are fully ripe, the ducts leading to the exterior are completely formed some little time before the elements are discharged. Each pouch has a single duct opening into a funnel-shaped depression through the epithelium on the dorso-lateral aspect of the body. The opening into the cavity of the ovary is on the surface of a broad papilla formed of long columnar cells, a portion of which bend inward to guard the opening. The ducts often have a somewhat tortuous course, and are likely to broaden out considerably in passing through the circular muscular layer.

Size.—The length of the largest individual observed was about 300 mm., and its width 6 mm.

The species is named in honor of Prof. A. E. Verrill, of Yale University, who, more than any one else, has helped to bring the American species of Nemerteans into orderly arrangement.

Stimpson¹ briefly describes from Bering Strait a species of *Cerebratulus* (*C. impressus* = *Micrura impressa*) which bears a superficial resemblance to the above. Stimpson's species, however, was flattened,

¹Proc. Philadelphia Acad. Nat. Sci., p. 160, 1857.

of a dusky gray color above, with narrow, colorless, transverse lines, and with a flesh-colored subtruncate head, much narrower than the body. The same author describes a somewhat similar species (*C. bellus* = *Micrura bella*) from Yezo Island, Japan. This had 10 bluish-white, narrow transverse lines across the ashy-gray dorsal surface, and a white ventral surface. The head was short, and of a vermilion color. Both these species should be referred to the genus *Micrura* as here defined.

Habitat.—This species was found only at Virgin Bay, in Prince William Sound. Here it was not uncommon under stones at low water, and was frequently met with in the parchment like tubes of *Carinella capistrata*, with which it was associated.

26. MICRURA ALASKENSIS sp. nov.

Pl. IV, fig. 2; Pl. XIII, fig. 1.

Body long and slender, rounded in esophageal region, flattened throughout the whole intestinal region. Head remarkably slender, elongated, and sharply pointed; cephalic furrows correspondingly long, but their anterior ends do not reach the proboscis pore. Mouth small, and well back from tip of snout; its anterior end reaches about as far forward as posterior ends of cephalic furrows.

No ocelli are present. The brain is reddish in color, and shows conspicuously through the tissues external to it.

The esophageal region is well rounded, and narrower than the succeeding portion of the body. The intestinal region is much flattened both above and below; its lateral margins are rounded, however. After preservation in alcohol the intestinal region is flattened or even hollowed ventrally, while the dorsal surface is very convex. Posteriorly the body tapers gradually, and at its pointed extremity an unusually long caudal cirrus is present. This is quite colorless, and contracts after preservation to but a fraction of its original size and length.

Color.—Two color varieties were met with. Most commonly the general color was a salmon or flesh-color. The esophageal region was pale salmon with tinges of brighter red, becoming lighter anteriorly; the head pale or nearly colorless; the brain region distinctly red; the intestinal region pale salmon, with much more deeply colored intestinal lobes. Running the whole length of the ventral side of the body—from near the mouth to the caudal cirrus—is a characteristic, narrow, cream or flesh-colored stripe in the median line. This stripe is conspicuous only in the intestinal region, though it may be traced forward to the mouth, as stated. In alcoholic specimens it can still be detected

in the intestinal region, though the natural color of the body has mostly disappeared. A similar, though much less conspicuously marked, median stripe occurs on the dorsal surface.

The second color variety had chestnut brown intestinal lobes, brownish esophageal region, slightly paler below; snout and margins of head colorless; brain red. The paler, ventral, median stripe was even more conspicuous than in the other variety.

Serial sections show that, while the cephalic furrows are unusually long, yet they are not really as deep as in many related species. The brain is very large; the posterior end of each dorsal ganglion is bilobed, the dorsal lobe ending freely, while the ventral lobe continues directly into the cerebral sense organ. The canals from the sense organs open into the very posterior ends of the cephalic furrows. The buccal, or esophageal, nerves are larger than in most species.

Accessory buccal glands.—On each side of the mouth, and extending a short distance into the esophageal region, is a series of peculiar glands—accessory buccal glands, they may be called. These glands are similar in their nature to, and apparently supplement, the ordinary buccal glands which line the mouth cavity. In the present instance, however, these accessory glands lie imbedded in the outer longitudinal muscular layer ventral to the lateral nerves. Here they greatly encroach upon the domain of the muscles, and occupy a large portion of the space between the circular muscular layer and the cutis (pl. XIII, fig. 1). The gland cells are large, and are distended with a clear, granular secretion. These accessory glands appear to have originated from ordinary buccal glands which have passed outward and taken up a position outside the two inner muscular layers (pl. XIII, fig. 1). They are arranged in clusters, and discharge their contents by irregular ducts leading through the two inner muscular layers to the epithelium of the buccal cavity and adjacent esophageal wall. A short distance back of the mouth the two lateral series of these accessory buccal glands unite beneath the esophagus, and are not found further posteriorly. The ordinary buccal glands are present as in related species.

Alimentary canal.—The *esophagus* is large in comparison with the thickness of the body wall. The histological difference between the epithelium lining its anterior portion and that of its posterior half is much more marked than in most related species. The delicate layer of circular and longitudinal muscular fibers which surrounds the epithelial lining of the esophagus in most of the Heteronemerteans becomes remarkably developed in this species. At the very posterior end of the esophagus—just anterior to the first intestinal pouches—

the circular muscles of the esophagus increase so greatly in number that they form a most conspicuous layer. In the region of its maximum development this layer becomes nearly half as thick as the circular layer of the body walls in the same section. In no other species of the *Lincidae* has this muscle been found of even approximately this thickness. Its fibers connect in part with the circular layer of the body walls, and to a lesser degree with the circular muscles of the proboscis sheath. But few fibers lie on the dorsal wall of the esophagus, so that this organ is largely bound up with the proboscis sheath in a continuous layer of muscles, and one cannot fail to see the striking resemblance between this circular layer and the inner circular muscles that are so highly developed in precisely the same region in *Carinoma* (p. 22).

Body walls.—The external longitudinal muscular layer of the body walls is especially weak when compared with the same layer in related species. This is partly shown by the fact that the cutis glands extend $\frac{3}{4}$ or more of the distance from the exterior to the circular muscular layer. Nearer the intestinal region the muscular layers are thicker, and the esophagus occupies correspondingly less space.

The three longitudinal blood vessels are very conspicuous throughout their length. The dorsal vessel leaves the proboscis sheath near the posterior ends of the nephridia, or at about $\frac{2}{3}$ the distance towards the posterior end of the esophageal region.

Nephridia.—The nephridial system consists of a pair of unusually large, longitudinal canals, which lie in the dorsal walls of the lateral blood lacunæ beside the esophagus. The nephridial canals send off very few branches, except near their anterior ends, where they divide into smaller branches. The main canals extend through about the middle third of the esophageal region. Each of the pair of longitudinal canals terminates posteriorly in a single, remarkably large efferent duct which opens on the dorso-lateral aspect of the body. The ducts sometimes lie exactly opposite, but in other specimens one lies some distance farther back than the other. In such cases, of course, one of the nephridia extends a corresponding distance farther posteriorly than the other. Each of the efferent ducts spreads out as it passes through the circular muscular layer into a broad sieve-like or filter-like structure with scores of small, nucleated cells. From this point a straight and comparatively narrow duct leads directly to the surface.

Reproductive glands.—The sexual elements are fully mature in the month of June, and the genital ducts at this time are fully formed. In the females each duct communicates directly with the cavity of the ovary by a funnel-shaped opening, and a similar funnel-shaped open-

ing lies at the outer end of the oviduct on the dorso-lateral aspect of the body. The bodies of many of these worms were so distended with sexual products that they were very easily ruptured and could consequently be preserved intact only with great care.

Size.—The length of this species is commonly about 150 mm. in extension, although several individuals were found which were more than 300 mm. long.

Habitat.—The species was found under stones between tides in rather muddy localities at New Metlakahtla on Annette Island, at Glacier Bay, Sitka, Yakutat, and at Orca and Virgin Bay in Prince William Sound. At the four last-named localities the worms were abundant. Nearly 50 individuals, some of them nearly 300 mm. long, were found at Sitka massed together in a single cavity in coarse gravel mixed with mud. All were filled with fully mature sexual products, and the bodies of nearly all were in contact in a tangled mass.

CEREBRATULUS Renier.

Prospetto della Classe dei Vermi (t. Bürger), 1804.

The species of this genus are distinguished by long, flattened bodies, the lateral margins of which are thin, adapted for swimming. Most species are very active, swim readily with undulatory motion, can roll up spirally and become twisted, but are only moderately contractile in length, and do not draw together into a tangled mass. The dorso-ventral musculature is highly developed, as are likewise the longitudinal and oblique muscles.

Head usually pointed anteriorly, but very changeable in shape; lateral slits long and deep; proboscis pore terminal; mouth large, and situated behind the ganglia; esophageal region mostly rounded; intestinal region broad and flat with thin lateral margins; the posterior end extremely flattened and provided with a delicate caudal cirrus, which extends beyond the opening of the intestine, and in most species is easily broken off and lost. Eyes usually wanting; body commonly of a nearly homogeneous color without distinct markings (such as longitudinal and circular bands and rings).

Proboscis sheath reaches to posterior end of body; proboscis very long and strong. Intestinal pouches deep and mostly forked peripherally; central intestinal canal narrow. Neurochord cells probably commonly present in brain and lateral nerve cords, though they have as yet been found in but few species.

27. CEREBRATULUS HERCULEUS sp. nov.

pl. 1, fig. 5.

Body very large, stout, thick, broad, attaining a length of 2 meters or more, and a breadth of more than 25 mm.; remarkably broad when contracted, the body somewhat resembling that of a leech. One specimen, preserved in alcohol and strongly contracted, now measures 300 mm. in length, 25 mm. in width in intestinal region; 18 mm. in width and 15 mm. in thickness in esophageal region. The length of the esophageal region in this specimen is only about 55 mm. after preservation.

Head very short, thick, and bluntly pointed. Cephalic slits short, separated in front, reaching back in the alcoholic specimen but 7 mm. Mouth large, situated as far back as the posterior end of the cephalic furrows.

Esophageal region short and thick; intestinal region very broad and flat, with thin, wavy margins in life. Posterior extremity provided with a pale caudal cirrus of comparatively small size. Proboscis large, colorless, fully equal in size to that of a large specimen of *C. marginatus*. No ocelli.

Color.—Color very dark brown or reddish brown throughout the whole dorsal surface, rather paler and less bright ventrally.

This gigantic Nemertean is not clumsy in its movements, but is active, and swims rapidly and gracefully. It was met with only at Sitka, where it occurred in considerable numbers in mud at low water mark, associated with *C. marginatus*. The worms are fragile, and break spontaneously unless carefully handled.

28. CEREBRATULUS MARGINATUS Renier.

Cerebratulus marginatus RENIER, Prospetto della Classe dei Vermi (t. Bürger), 1804.

C. angulatus MCINTOSH, British Annelids; Pt. 1, Nemerteans, p. 195, Ray Society, 1872-73.

C. fuscus VERRILL, Trans. Connecticut Acad., VIII, p. 438, 1892.

This large and active Nemertean was found in several localities about Sitka, but not in great numbers. The individuals there found possess the typical color of the species, with which they agree externally in every detail except the shape of the body. All the Alaska specimens are much shorter and comparatively broader than those I have seen in Naples, although careful study of microscopic sections revealed no essential anatomical differences. It is therefore probable that this is but a local peculiarity of a single widely distributed species.

The worms were found near low water mark living in soft black mud beneath a considerable growth of 'eel grass.' The mud contained a great quantity of decomposed vegetable matter, and was saturated with sulphuretted hydrogen. The worms are excellent swimmers, and are very rapid in their movements in their underground burrows.

The specimens obtained measured up to 500 mm. or more in length, and about 15 mm. in width.

The color above was slaty-brown, dark gray, or greenish-gray, with white or colorless margins.

The species has been previously recorded from the Mediterranean, the coasts of Great Britain, Madeira, the northeastern coast of America, Greenland, and from other localities.

29. *CEREBRATULUS OCCIDENTALIS* sp. nov.

Pl. VI, fig. 3.

Body 300 mm. or more in length in moderate extension; rather slender, rounded in front, flattened behind, and with very thin margins in the intestinal region, as in other species of the genus. Head changeable in shape, either rounded or acutely pointed, according to state of contraction. Cephalic furrows rather short.

Color.—Individuals vary considerably in the general color of body, but are most commonly chestnut brown or dull reddish anteriorly, and light chocolate brown in the intestinal region. The ventral surface is brownish flesh-colored, with a median, ochre ventral stripe. Sometimes the ventral surface is nearly chocolate throughout its entire length. A darker median dorsal stripe is indicated.

Proboscis.—Remarkably small and slender, being many times smaller than in most related species of equal size. It is colorless, and is usually everted when the animal is killed.

In internal anatomy but few points need special mention. The cephalic glands are unusually well developed, and continue backward as the cutis glands. The brain is remarkably voluminous, the dorsal ganglion bilobed, the lower lobe continuing into the cerebral sense organ.

The mouth is very large, and is provided with an unusual abundance of buccal glands. There are many diagonal fibers between the proboscis sheath and the body musculature.

Nephridia.—The nephridia are of moderate length, and occupy the middle third of the esophageal region. The main tubules lie in the angles between the esophagus and the proboscis sheath. They are profusely branched towards their anterior ends, each branch lying in

the wall of one of the esophagal blood lacunæ. Farther back the branches unite into a single tubule on each side. Their main canal continues backward for a considerable distance in the wall of a lateral blood lacuna, and is without branches. At its posterior extremity the efferent duct bends to the dorso-lateral surface of the body, as usual.

The sexual products are fully mature in July.

Habitat.—This is a very active species. It was found in abundance at Wrangell, Yakutat, Orca, and Virgin Bay. It inhabits the shore at half tide and below, in muddy places and under stones. The small size of the proboscis will distinguish it from related species.

30. *CEREBRATULUS LONGICEPS* sp. nov.

Pl. v, figs. 4, 5, 6, 7.

Body much flattened throughout its whole length; anterior portion remarkably narrow and slender, becoming wider posteriorly. Head much narrower, more slender, and longer than in most species of the genus, acutely pointed in front, much flattened dorso-ventrally, and with the tip of the snout often slightly curved upward. A section through the head is often concave both above and below, showing that the head is thicker laterally than in the median line. The head is directly continuous with succeeding portions of the body. Frontal sense organs very highly developed.

Cephalic furrows very long, and remarkably deep and wide. Anteriorly they do not reach quite to tip of snout. They are, consequently, well separated from the proboscis pore, which is situated subterminally. The mouth is situated as far back as the posterior end of the cephalic furrows.

From the narrow, pointed head the esophagal region gradually widens as it passes backward, but it remains unusually flat throughout; the intestinal region is not sharply marked off from the esophagal region, but widens gradually toward the posterior third of the body, and narrows toward the posterior extremity. The intestinal region is even flatter than the more anterior portion of the body. The caudal cirrus was not observed.

Proboscis.—The proboscis sheath is reduced to a frail tubule in the posterior third of the intestinal region. The proboscis is slender and colorless; it has the three muscular layers and the muscular crosses, as usual in the genus.

Color.—Dorsal surface dark brownish-black or purplish, much paler on tip of snout, and on borders of cephalic furrows. This paler border is wider on the ventral than on the dorsal borders of the furrows. It

is sometimes so much increased that it covers the whole ventral surface in the region of the mouth, and gradually becomes darker toward the tip of the snout, as well as posteriorly. The color of the ventral surface is similar to that of the dorsal surface, but is commonly slightly paler, especially anteriorly, and has a grayish tinge.

No eyes were found.

Size.—Length of largest specimens collected about 300 mm.; width in intestinal region 6 mm.

The body is fragile, and the specimens are often broken in killing. After preservation in formalin or alcohol the body tapers gradually toward the narrow head, is widest in the posterior third or near the posterior end, and greatly flattened throughout. The head retains its long, pointed appearance, the tip is recurved, and the cephalic furrows in most specimens are deep and widely open.

Frontal sense organs.—On the exact tip of the head are three rather deep and wide pits, easily overlooked in the entire animal, but very conspicuous in sections. These are undoubtedly sensory in their nature, and are lined with slender rod-like cells with especially large cilia. Bürger has described in detail such sense organs in *Micrura* and *Cerebratulus*, and somewhat similar ones in other genera. These 'frontal organs,' as they are called, lie above the proboscis pore; one of them is situated in the median line and the other two are placed symmetrically on the antero-lateral margins.

The *brain* is remarkably large, and the dorsal ganglia are much larger than the ventral. The posterior ends of the long lateral furrows are greatly expanded.

Cerebral sense organs.—These also are very voluminous and are continuous with the posterior ends of the dorsal ganglia. The canals leading to the exterior are large, and open into the posterior ends of the cephalic furrows. Internally each canal passes directly beneath the dorsal ganglion to its internal ventral border, and then bends dorso-laterally to the external border of the sense organ. These canals leave the cephalic furrows far back of the cerebral commissure, and at about the point where the ventral ganglia merge into the lateral cords.

Nephridia.—The nephridial system presents remarkable deviations from the type usually found in the genus. The nephridial canals extend throughout the whole length of the esophageal region, and communicate with the exterior by upwards of *sixty* efferent ducts on each side. In the region of the mouth, or directly behind it, are one or two nephridial tubules on each side, quite independent of the rest of the system. Each of these tubules consists of a coil of fine canals lying

on the dorsal side of the lateral blood lacunæ, and projecting freely into the cavity of the lacuna. From each coiled tubule an efferent duct leads directly to the dorsal surface of the body. Back of these anterior, isolated nephridia a continuous richly branched and much coiled canal extends posteriorly on each side as far as the end of the esophageal region. The branches of these canals are limited to the dorsal and lateral surfaces of the lateral blood spaces, which occupy the angles between the esophagus and the proboscis sheath. The coiled tubules project freely into the blood spaces, and encroach considerably upon their area. The very numerous efferent ducts, which are given off from these tubules, pass directly outwards to the surface of the body. Those which pass out from the most lateral of the nephridial tubules, open on the dorsal surface near the lateral margins of the body, while those which leave the tubules nearest to the proboscis sheath open on the dorsal surface not far from the median line. The greater portion of the nephridiopores, however, lie rather nearer to the lateral margins than to the median dorsal line. Although there are practically the same number of efferent ducts on each side, this does not signify that these ducts are paired, but rather that the average number on each side is identical. In several instances an unusually large efferent duct on one side was accompanied by one of similar size nearly opposite. These ducts vary greatly in size, some being several times as large as others. Great irregularity likewise exists as to their distribution along the course of the nephridial canal. In the anterior third of the esophageal region they are well separated, but more posteriorly, portions of two or three sometimes appear on the same side in a single section.

Sexual glands.—The reproductive glands appear immediately behind the nephridia, and in both sexes alternate with the intestinal pouches. The sexual products were fully mature in July, and in both sexes the genital ducts were fully formed. They were lined with a special flattened epithelium, and opened on the dorso-lateral aspects of the body in both sexes. The ova when immature are attached by a narrow stalk to the wall of the ovary, and later break off and fall into the ovarian cavity. The spermatozoa have short, oval heads instead of the slender, pointed ones so common in the genus.

Habitat.—Yakutat; under stones at low water; not common.

31. *CEREBRATULUS MONTGOMERYI* sp. nov.

Pl. VI, figs. 1 and 2.

Body large, very long and ribbon-like when fully grown, and much flattened, except in esophageal region. Head variable in shape, according to state of contraction; sometimes rounded and obtuse, at other times much elongated, pear-shaped, and flattened dorso-ventrally. The anterior portion of the body, back as far as the intestinal region, is narrower and thicker than the posterior portions, and has rounded margins; in the intestinal region the body is very flat, and the lateral margins are extended to very thin edges. In partial contraction the dorso-ventral muscles, situated a little distance from the outer edge of the margins, contract so strongly as to produce a lateral ridge on each side both above and below the lateral edge. A transverse section consequently shows that the lateral margin is thicker distally than it is nearer the median line. These lateral ridges are often seen in specimens preserved in alcohol or formalin. Posteriorly the body becomes still thinner, and is narrower toward the extremity. The posterior end is either obtuse or sharply pointed, according to the state of contraction. The posterior opening of the intestine is subterminal. In none of the many specimens obtained was the caudal cirrus present, though such an appendage is probably present in uninjured worms.

The cephalic slits are moderately elongated, and extend backward as far as the anterior end of the mouth. Their posterior ends are wide and deep, and in life their margins are thin and widely separated. Anteriorly they do not reach quite to the proboscis pore, except when the animal is strongly contracted.

Color.—In life the whole body, both above and below, except the tip of the head, is bright blood red. The anterior extremity is tipped with a narrow band of white or yellowish-white. This white tip extends both above and below, and is not usually more than a few millimeters wide. The proboscis is light red in color.

Size.—Individuals were most commonly from one to two meters in length, and 8 to 10 mm. in width in the intestinal region. A few of the specimens obtained measured as much as two and a half meters when extended.

The individuals are generally hardy, and are not so prone to break spontaneously into fragments as are those of many other species of the genus. They contract much less violently than most other Nemerteans when killed, and may consequently be easily preserved entire by killing in a dilute solution of formalin in sea water.

Proboscis.—The proboscis is pale red, and of moderate size for the genus. Its musculature consists of an inner circular, a longitudinal, and a very thin outer circular muscular layer. It is, therefore, different from those of nearly all the species of the family *Lineidae*, in that the inner longitudinal muscular layer is wanting. There are fibers passing between the inner circular layer and the thin outer circular layer, but these fibers do not form such distinct crosses as are characteristic of most of the members of the family. The internal epithelium is thick and highly glandular. The nerve plexus beneath this layer is unusually conspicuous, and lies directly internal to the circular muscular layer. The proboscis is very often retained in place after the animal has been killed. The muscular layers of the proboscis sheath are rather thick, and the circular muscular fibers often cross into the circular muscles of the body in the median line.

In the anterior portion of the head a rich growth of glands penetrates the other tissue nearly to the central proboscis sheath. These glands mostly open directly outward on the whole circumference of the head, although a few open on the tip of the snout. Back of the lateral slits the glands are restricted to the cutis. In the region of the mouth the cutis glands are separated from the outer epithelium by a layer of interlaced fibers of connective tissue, forming a basement layer of double the thickness of the epithelium. In the intestinal region the cutis glands are much reduced, and scattered. The outer muscular layer of the body is about as thick as the two inner muscular layers combined.

The mouth is much elongated, and its anterior end reaches forward as far as the posterior ends of the cephalic slits. The intestinal pouches are deep and narrow, and are forked distally.

Nephridia.—The nephridial canals are profusely branched, and lie in contact with the blood spaces around the esophagus in front of the middle esophageal region. Their extent longitudinally, however, is short. The main nephridial canals lie in the angles between the esophagus and the proboscis. Near their posterior extremities a large efferent duct passes obliquely upward on each side and opens on the latero-dorsal aspect of the body. As described by Bürger¹ in *C. marginatus*, one of the efferent ducts often lies far behind the other. Posterior to the efferent ducts the nephridial canals are smaller, and their branches end a short distance farther back. The blood lacunæ in the head in the specimens sectioned were very much reduced in size.

¹Fauna u. Flora Neapel, Monogr. 22, p. 622.

The brain lobes are large, and the ventral commissure enormously thick. The well developed cerebral sense organs abut closely against the posterior ends of the dorsal ganglia. Their ciliated canals pass obliquely inward from the posterior ends of the cephalic slits. In their course these canals pass external and ventral to the dorsal ganglia. The median dorsal nerve, lying just outside the circular muscular layer of the body, is large and conspicuous throughout nearly the whole length of the animal.

Ocelli are wanting in the adult worm.

In specimens collected in June and July the genital products had evidently been recently discharged.

This species is named in honor of Dr. T. H. Montgomery, Jr., of the University of Pennsylvania, whose studies on the Nemerteans form most valuable contributions to the knowledge of the group.

Habitat.—This magnificent Nemertean was found abundantly under stones in muddy places near low water mark at most of the collecting stations between Sitka and Unalaska. At Orca and Virgin Bay, in Prince William Sound, and at Dutch Harbor, Unalaska, it proved to be one of the commonest species. Professor Kincaid has sent me a large specimen from Puget Sound, in the State of Washington, where it is said to be not uncommon. This would indicate that the species may be found locally along the whole northwestern coast of North America south of Bering Sea.

32. *CEREBRATULUS ALBIFRONS* sp. nov.

Pl. IV, figs. 3, 4.

Body elongated, ribbon-like, flattened behind, rounded in front as in typical species of the genus. Margins of intestinal region pale and thin. Cephalic slits unusually long and deep, reaching well beyond posterior end of mouth.

Color.—General color of body brownish purple. Anterior end of head white, including both dorsal and ventral surfaces, and extending backward about as far as anterior end of mouth, and sometimes reaching along borders of cephalic slits to their ends. The esophageal region is dark smoky purple on dorsal surface; the ventral surface is similar but paler; the intestinal region inclines more to reddish. A darker line runs along the middle of the dorsal surface and the intestinal lobes appear more opaque.

Habitat.—Only a single specimen of this pretty species was secured, and this, unfortunately, had its posterior extremity missing. The specimen was about 150 mm. in length and of moderate propor-

tions. It was restless in confinement, and an active swimmer. It was found under a stone near low water mark at Hot Springs, near Sitka.

EXPLANATION OF PLATES.

The colored plates (I to VI) are reduced from colored sketches made, with a few exceptions, from the living animal. They were completed after the return of the expedition and have been retouched, and in some instances entirely redrawn, by Mr. A. H. Verrill. Every effort has been made to make the colors and the form of the body as natural as possible.

In the figures on the plates the following reference letters are used :

<i>ap</i> , attachment of proboscis.	<i>ifl</i> , inner fibrous layer.
<i>bg</i> , buccal glands.	<i>ilm</i> , inner longitudinal muscles.
<i>bg'</i> , accessory buccal glands.	<i>in</i> , intestine.
<i>bl</i> , blood lacuna.	<i>lm</i> , longitudinal muscles.
<i>ble</i> , epithelium of same.	<i>ln</i> , lateral nerve-cord.
<i>bm</i> , basement layer.	<i>m</i> , mouth.
<i>br</i> , brain.	<i>meφ</i> , epithelium of same.
<i>bv</i> , blood vessel.	<i>nc</i> , nerve commissure.
<i>bva</i> , anastomosis of lateral vessels.	<i>nd</i> , efferent nephridial duct.
<i>cc</i> , ciliated canal of cerebral sense organ.	<i>neφ</i> , nephridial canal.
<i>cgl</i> , cephalic glands.	<i>nφ</i> , nerve plexus.
<i>cm</i> , circular muscular layer.	<i>nv</i> , nerve.
<i>cso</i> , cerebral sense organ.	<i>oc</i> , ocellus.
<i>ct</i> , connective tissue.	<i>ocm</i> , outer circular muscles.
<i>cugl</i> , cutis glands.	<i>oeφ</i> , outer epithelium of proboscis.
<i>dc</i> , dorsal commissure of brain.	<i>olm</i> , outer longitudinal muscles.
<i>dg</i> , dorsal ganglion.	<i>ov</i> , ova.
<i>dgl</i> , secretion of cephalic glands.	<i>pcm</i> , circular muscles of proboscis.
<i>dn</i> , median dorsal nerve.	<i>plm</i> , longitudinal muscles of proboscis.
<i>e</i> , esophagus.	<i>pn</i> , proboscis nerve.
<i>ecφ</i> , epithelium of same.	<i>ps</i> , proboscis.
<i>f</i> , fibrous layer of cutis.	<i>psφ</i> , proboscis sheath or its cavity.
<i>gc</i> , glandular cells of cerebral sense organ.	<i>rh</i> , rhynchodæum.
<i>gl</i> , integumental glands.	<i>ro</i> , opening of same.
<i>gp</i> , genital pouch.	<i>smg</i> , submuscular glands.
<i>i</i> , integument.	<i>sn</i> , nerve to cerebral sense organ.
<i>ic</i> , intestinal cæcum.	<i>sop</i> , opening of ciliated canal of sense organ.
<i>icm</i> , inner circular muscular layer.	<i>vc</i> , ventral commissure of brain.
	<i>vg</i> , ventral ganglion.

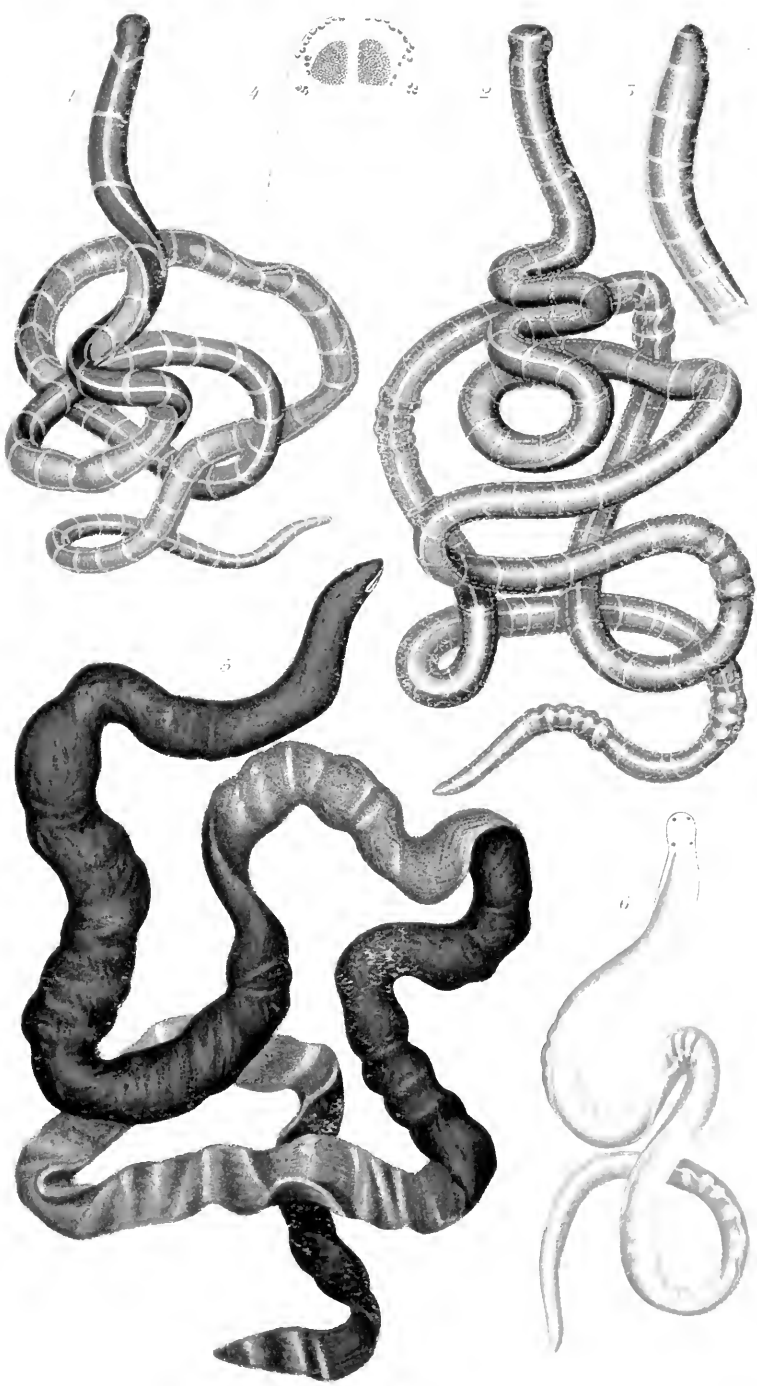
INDEX TO GENERA AND SPECIES.

New genera and species are in black face type; synonyms are in italics; pages on which generic or specific descriptions occur are in black face type.

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PLATE I.

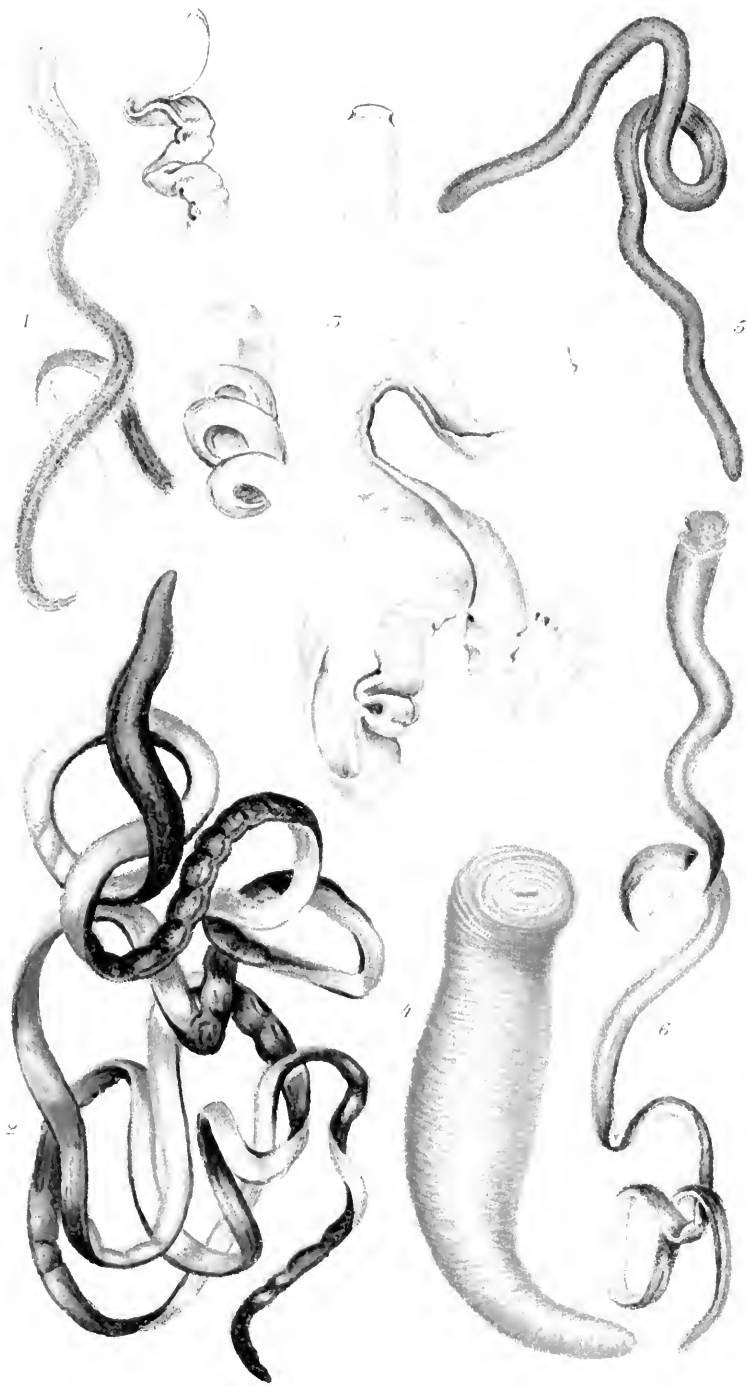
- FIG. 1. *Carinella capistrata* sp. nov. A large individual about natural size. Virgin Bay, Prince William Sound.
2. *Carinella dinema* sp. nov. Victoria, B. C. Enlarged $2\frac{1}{2}$ times.
3. Head of same species. Side view. Enlarged 4 times.
4. *Amphiporus bimaculatus* sp. nov. Dorsal view of head. Glacier Bay. Enlarged 12 times.
5. *Cerebratulus herculeus* sp. nov. A large individual. Sitka. Half natural size.
6. *Tetrastemma bicolor* sp. nov. Kadiak. Three times natural size.



ALASKA NEMERTEANS.

PLATE II.

- FIG. 1. *Emplectonema bürgeri* sp. nov. Anterior portion of an individual of the pale variety. Glacier Bay. $\frac{2}{3}$ natural size.
2. *E. bürgeri*. A large individual of the dark variety. Glacier Bay. $\frac{3}{4}$ natural size.
3. *Teniosoma princeps* sp. nov. Large individual. Yakutat. $\frac{1}{2}$ natural size.
4. *T. princeps*. A contracted specimen in formalin. Cape Fox. Natural size.
5. *Zygonemertes thalassina* sp. nov. Sitka. Twice natural size.
6. *Paranemertes peregrina* sp. nov. Brown variety. Victoria, B. C. A small specimen. Natural size. Compare pl. III, fig. 5.



ALASKA NEMERTEANS.

PLATE III.

- FIG. 1. *Amphiporus exilis* sp. nov. Glacier Bay. Slightly enlarged.
2. *Zygonemertes albida* sp. nov. Victoria, B. C. Enlarged $1\frac{1}{2}$ times.
3. *Paranemertes carnea* sp. nov. Taku Harbor. Anterior portion of body with emarginate head. Natural size.
4. *P. carnea*. Sitka. $\frac{2}{3}$ natural size.
5. *Paranemertes peregrina* sp. nov. Virgin Bay, Prince William Sound. $\frac{2}{3}$ natural size.
6. *Carinella speciosa* sp. nov. Hot Springs, near Sitka. $\frac{1}{2}$ natural size.



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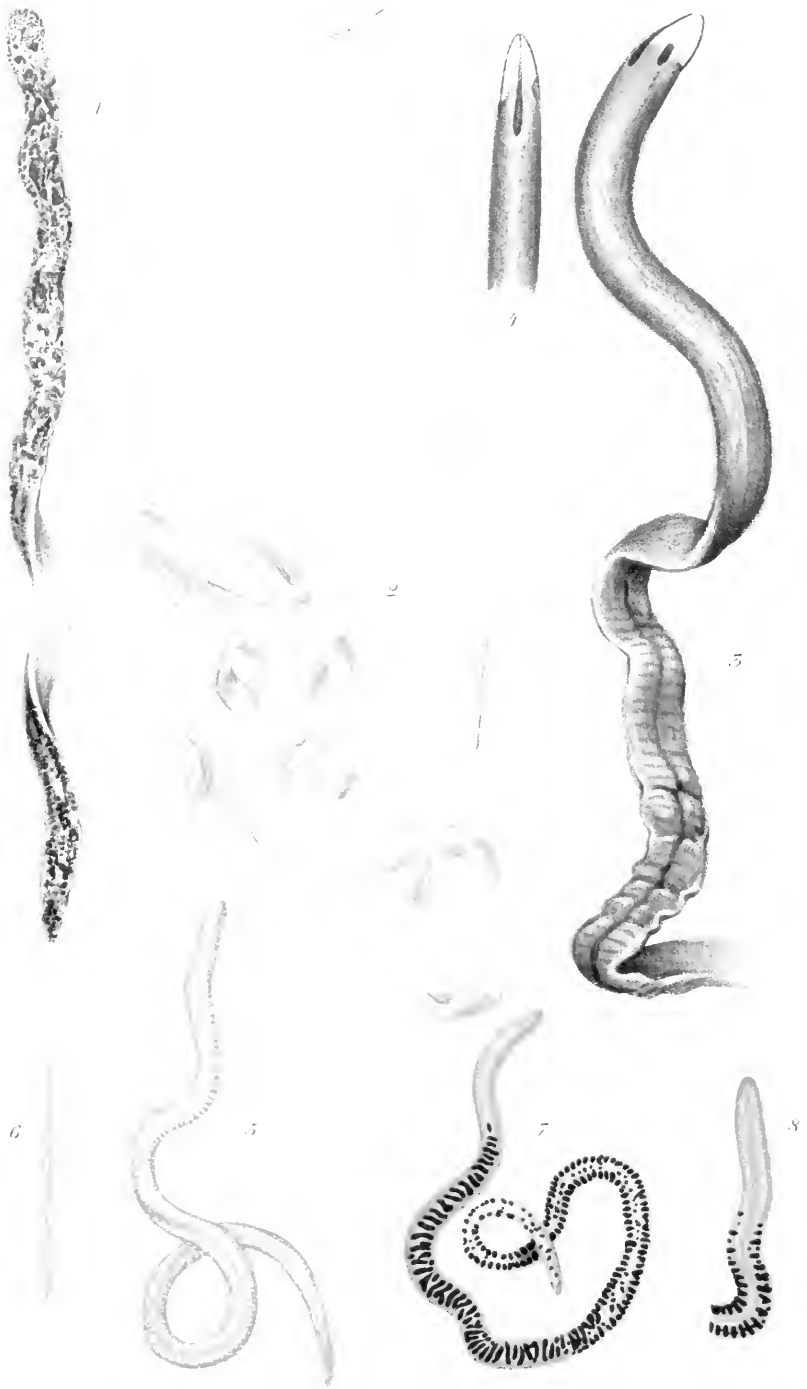


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PLATE IV.

- FIG. 1. *Amphiporus nebulosus* sp. nov. Kukak Bay, Alaska Peninsula. Natural size.
2. *Micrura alaskensis* sp. nov. Sitka. Enlarged $1\frac{1}{2}$ times.
3. *Cerebratulus albifrons* sp. nov. Near Sitka. Twice natural size.
4. Side view of head of same individual.
5. *Amphiporus tigrinus* sp. nov. Farragut Bay. Mature male specimen, slightly enlarged.
6. *A. tigrinus*. Head of male; dorsal view. Twice natural size.
7. *A. tigrinus*. Farragut Bay. Female with ripe ova. Slightly enlarged.
8. Head of female of same species. Dorsal view. Twice natural size.



ALASKA NEMERTEANS.

PLATE V.

- FIG. 1. *Micrura verrilli* sp. nov. Virgin Bay, Prince William Sound. Natural size.
2. Side view of head of same species.
3. The same; contracted.
4. *Cerebratulus longiceps* sp. nov. Yakutat. Enlarged $1\frac{1}{2}$ times.
- 5, 6, 7. Heads of same species, from lateral, dorsal, and ventral aspects respectively.
8. *Lineus torquatus* sp. nov. Orca, Prince William Sound. Natural size.
9. *L. torquatus*. Side view of head.
10. *Amphiporus bimaculatus* sp. nov. Victoria, B. C. Natural size.

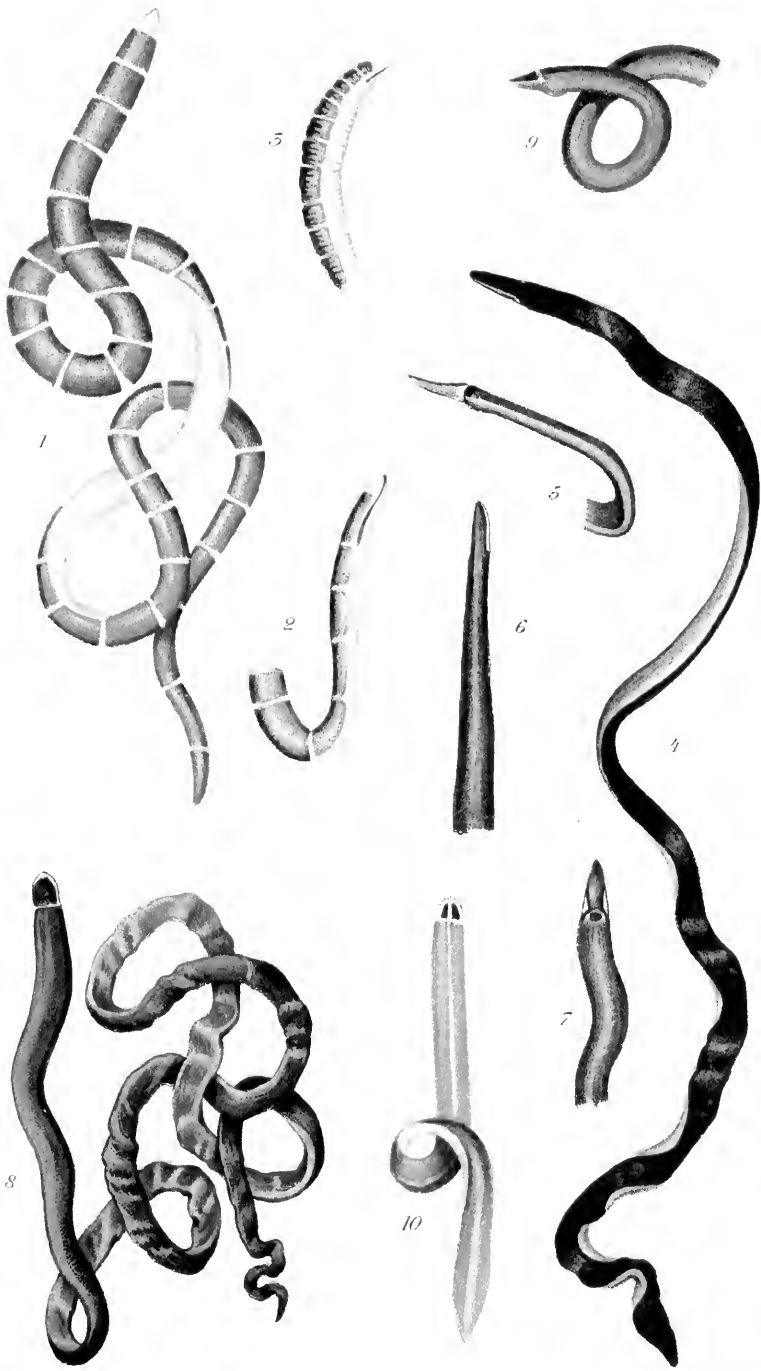
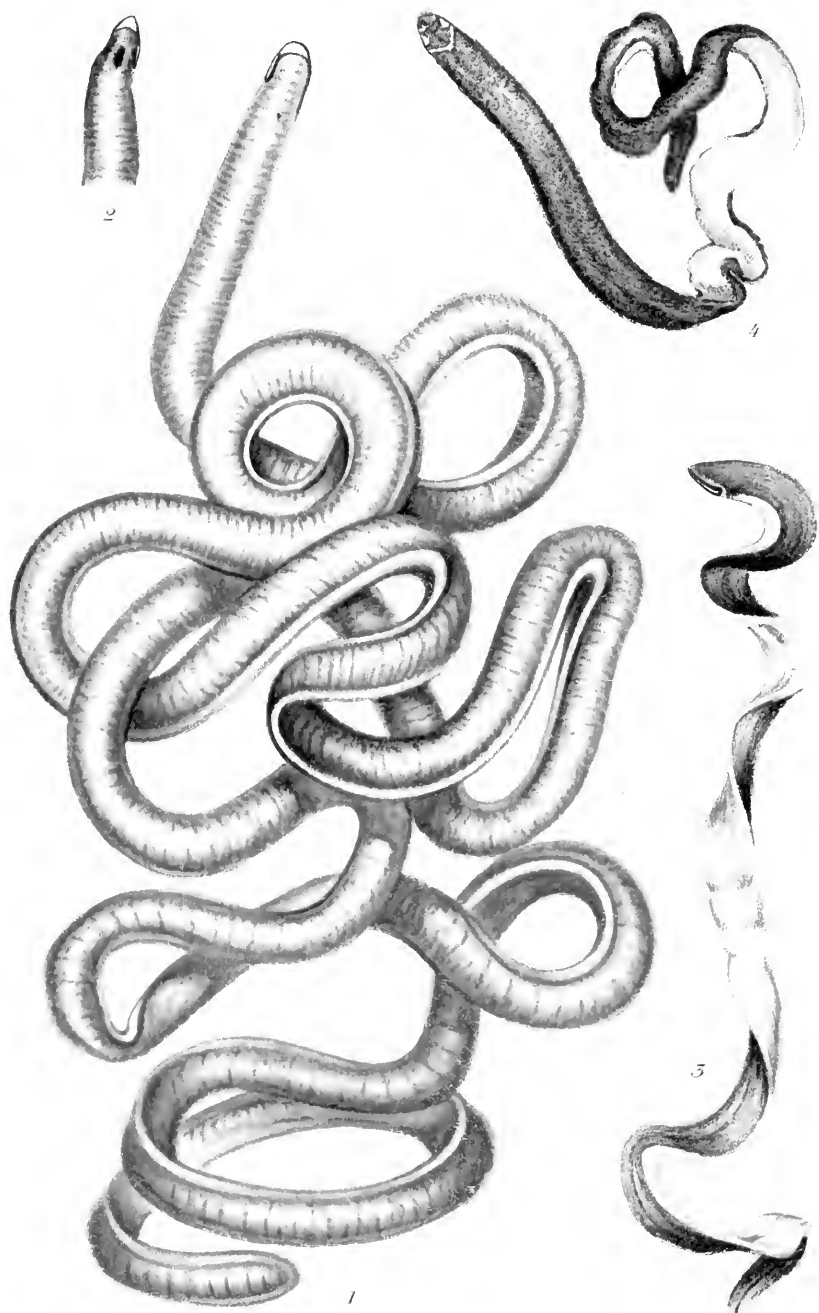


PLATE VI.

- FIG. 1. *Cerebratulus montgomeryi* sp. nov. Dutch Harbor, Unalaska. Natural size.
2. Head of same species from ventral surface.
3. *Cerebratulus occidentalis* sp. nov. Yakutat. Natural size.
4. *Amphiporus angulatus* (Fabr.) Verrill. Kadiak. Natural size of large specimen.



ALASKA NEMERTEANS.

G. Mearns. In Boston.

PLATE VII.

- FIG. 1. *Zygonemertes thalassina*. Outline of stylet apparatus of proboscis ($\times 50$). 1a, 1b, several accessory stylets from two individuals ($\times 225$). Sitka.
2. *Amphiporus angulatus*. Central portion of proboscis ($\times 40$). Taku Harbor. 2a, central stylet and basis of another specimen ($\times 80$).
3. *Paranemertes pallida*. Outline of middle region of proboscis ($\times 60$).
4. *P. carnea*. Extremity of everted proboscis, with six pouches of accessory stylets, of which but four are shown ($\times 35$). Sitka.
5. *Amphiporus exilis*. Middle portion of proboscis, indicating, besides central stylet and basis, eight pouches of accessory stylets ($\times 40$). Yakutat.
6. *Amphiporus leuciodus*. Stylet apparatus of proboscis showing the three accessory stylet pouches ($\times 60$). Victoria, B. C.
7. *Paranemertes peregrina*. Outline of middle portion of proboscis ($\times 50$). Virgin Bay.

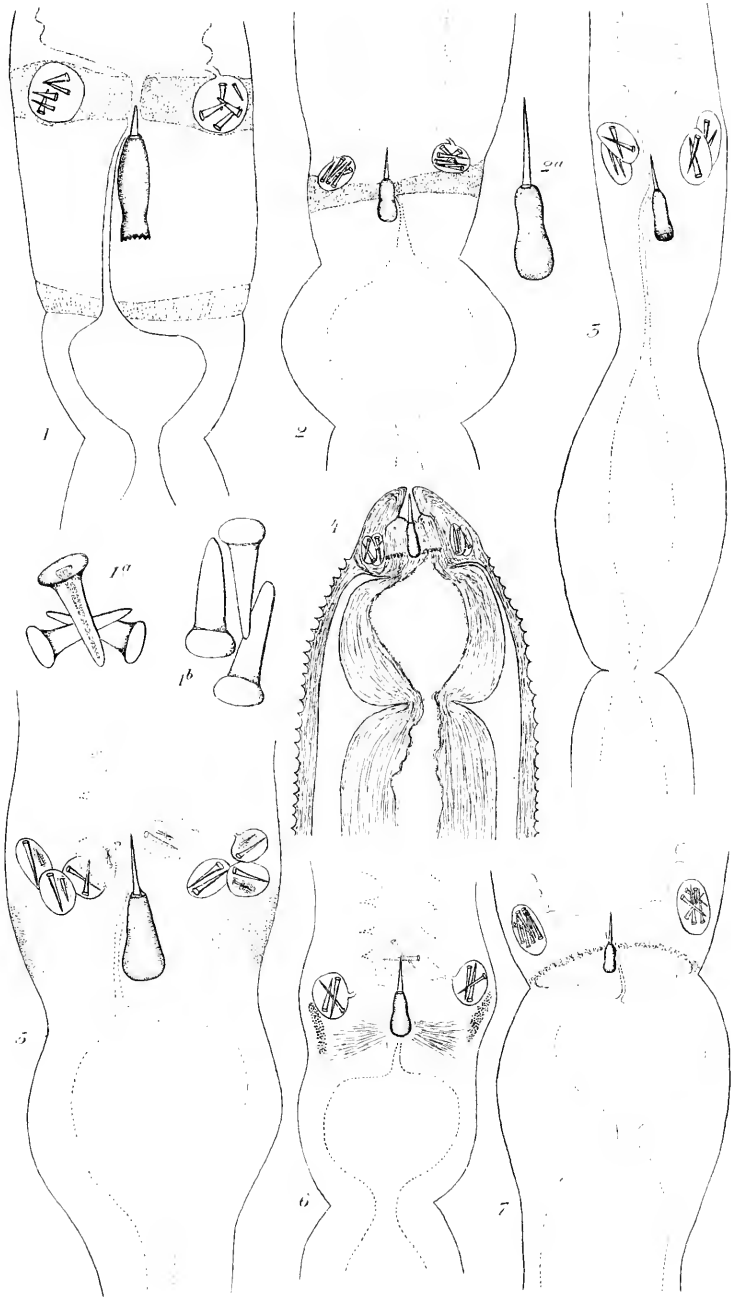


PLATE VIII.

- FIG. 1. *Emplectonema bürgeri*. Outline of stylet apparatus ($\times 35$). Glacier Bay.
2. *Amphiporus bimaculatus*. Middle portion of proboscis, with four pouches of accessory stylets ($\times 35$). Glacier Bay.
3. *Emplectonema gracile*. Stylet apparatus of proboscis ($\times 50$). Popof Island.
4. *Amphiporus tigrinus*. Middle region of proboscis ($\times 60$). Farragut Bay. The deeply stained wreath of glands is indicated only in section.
5. *Zygonemertes albida*. Middle portion of proboscis ($\times 40$). Victoria, B. C.
6. *Amphiporus nebulosus*. Outline of stylet apparatus of proboscis ($\times 50$). Kukak Bay.
7. *Paranemertes carnea*. Side view of head, with partially everted proboscis. The position of the lateral oblique furrows, and the arrangement of the ocelli are indicated ($\times 5$). Taku Harbor.

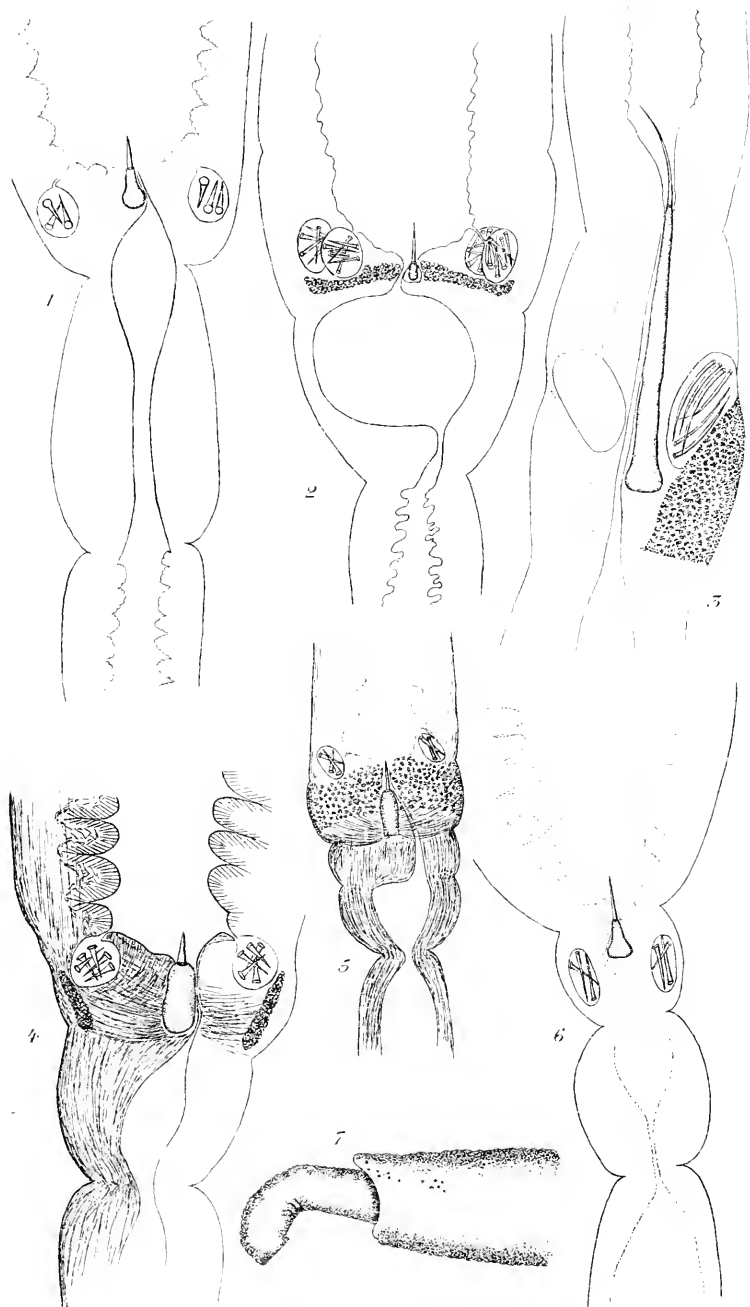




PLATE IX.

FIG. 1. *Carinella speciosa*. Transverse section through head in front of brain showing, particularly, position of enormously developed cephalic glands (*cgl*) and arrangement of cephalic nerves (*nv*). The cephalic glands are thickly placed both above and below the cephalic blood lacunæ (*bl*), as well as around the rhynchodæum (*rh*). The secretion from many of these glands is discharged near the lateral margins as indicated (*dgl*). Between the longitudinal and oblique muscles (*lm*), which lie in the deeper parts of the head, and the circular fibrous layer (*cm*), composed of muscles and connective tissue fibers underlying the integument (*i*), are numerous and very massive nerves (*nv*) which supply the head regions in front of the brain. The broad indentation on the ventral margin has no relation to the mouth, which lies much farther back. Other reference letters are explained above (p. 83). A small individual. ($\times 45$).

2. *Carinella speciosa*. Transverse, but somewhat oblique, section through head in region of brain. On the right of the section the brain (*dgc* and *vgc*) lies directly beneath the circular fibers (*cm*). External to the brain, and lying among the bases of the integumental cells, is the highly specialized cerebral sense organ (*cso*), connected with the dorsal ganglion (*dgc*) by several small nerves (*sn*). The cerebral sense organ shows a conspicuous central canal. The rhynchodæum (*rh*) has lost its fringe of gland cells, these being limited to the regions anterior to it. The outer portion of the circular layer (*cm*) constitutes the basement membrane of the integument. In the region of the brain the circular layer splits into two sheets, one passing external to the brain and the other (*it*) internal. Other reference letters as above. A large specimen. ($\times 25$).

3. *Carinella speciosa*. Transverse section through nephridial region showing positions, and one of the openings, of the nephridial canals. The lateral blood lacuna (*blv*) and the nephridial canal (*nep*) lie embedded in a band of loose connective tissue on each side. The opening of one of the efferent nephridial ducts (*nd*) is seen on the right of the drawing. Other reference letters as indicated above. ($\times 25$).

PLATE X.

- FIG. 1. *Carinella speciosa*. Portion of transverse section through nephridial region. The ciliated nephridial canal (*neφ*) shows the peculiar infolding of the integumental cells on its dorsal border. These integumental cells are here loosely arranged, and show several deep infoldings (*of*) which, under certain circumstances, may possibly have a more or less distinct communication with the nephridial canal. But a small portion of the closely packed gland cells in the integument are indicated. Reference letters are explained on p. 83. ($\times 75$).
2. *Carinella speciosa*. Portion of a transverse section through the brain region. The relation of the dorsal ganglion (*dgr*) with the highly specialized cerebral sense organ (*aso*) is indicated. The ciliated canal (*cc*) of the sense organ connects directly with the exterior by a narrow tube (*sop*)—shown in dotted lines in the drawing, because it lies mainly in another section—opening on the lateral margin of the head. Several nerves (*sn*) are seen to pass from the dorsal ganglion to the sense organ. Other reference letters as above. Only a small portion of the integumental gland cells are shown. ($\times 75$).
3. *Amphiporus tigrinus*. Dorsal view of anterior portion of body, cleared in cedar oil. In front of the brain the arrangement of the ocelli is shown, and farther back the position of the ovaries (*ov*). The intestinal cæca are not indicated. Farragut Bay. ($\times 8$).
4. *Amphiporus tigrinus*. Median sagittal section through the anterior portion of the body. The cephalic glands (*cgl*) lie above the opening of the rhyncodæum (*ro*). The mouth (*m*) separates from the proboscis opening a little way back. The attachment (*ap*) of the proboscis to the tissues of the head is seen to be well in front of the brain commissures (*dc* and *vc*). The section shows the comparative size and arrangement of the proboscis, blood vessels, esophagus, and other organs. Reference letters as above. ($\times 30$).

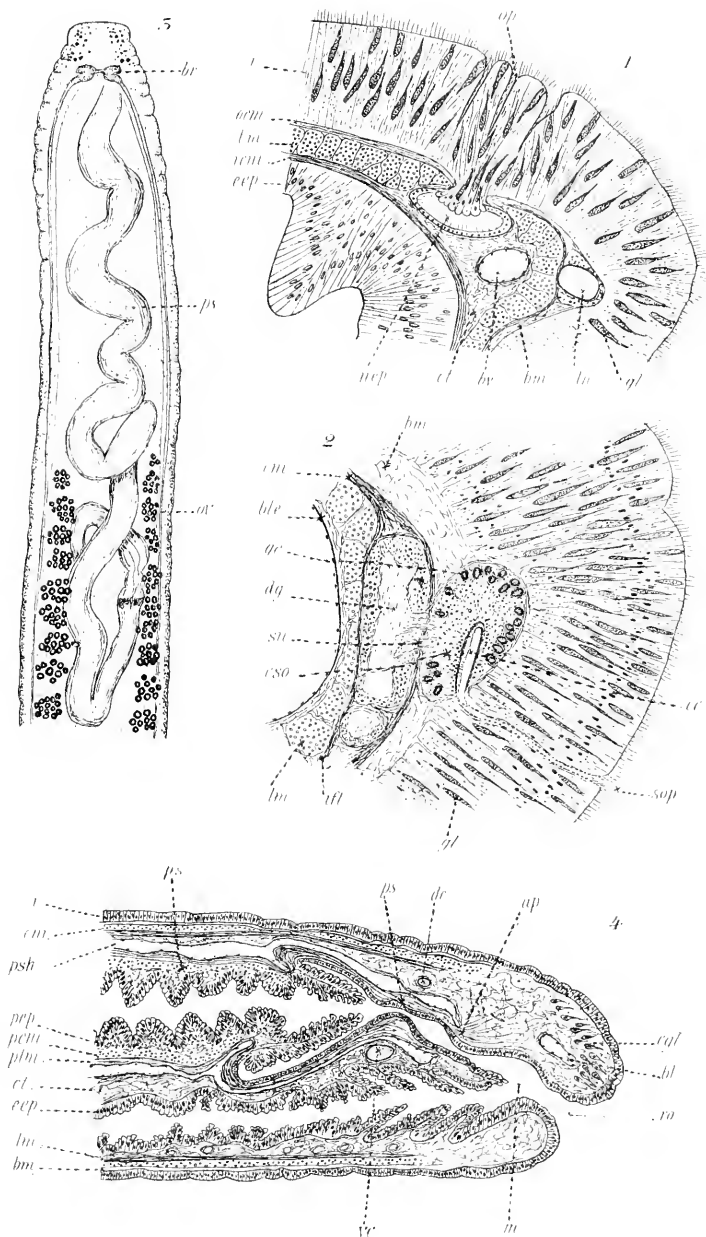




PLATE XI.

- FIG. 1. *Amphiporus nebulosus*. Transverse section through posterior portion of ventral commissure of brain. The submuscular glands (*smg*) fill up a large portion of the tissues of the ventral half of the head. The pair of nerves leading forward to the cerebral sense organs is seen to originate (*son*) from the ventral side of the dorsal ganglia. Other reference letters are explained on p. 83. ($\times 26$).
2. *Amphiporus angulatus*. Transverse section through ventral commissure of brain. The dorsal attachment of the proboscis to the tissues of the head is shown. The proboscis nerves (*pn*) enter the ventral side of the proboscis, and divide into a definite number of branches (usually 18), which farther back arrange themselves symmetrically about the periphery. The roots of the dorsal brain commissure (*rdc*) are indicated. In the right half of the section the anterior ends of the nephridial tubules (*ncp*) are seen. Submuscular glands (*smg*) are not as numerous as in *A. nebulosus*. Other reference letters as above. ($\times 26$).
3. *Amphiporus exilis*. Transverse section through nephridial region to show efferent nephridial ducts (*ncp*) opening on dorso-lateral aspects of body. This condition is extremely rare in Metanemerteans. Several diverticula of the intestinal cæcum (*inc*) are represented. Other reference letters as above. ($\times 32$).

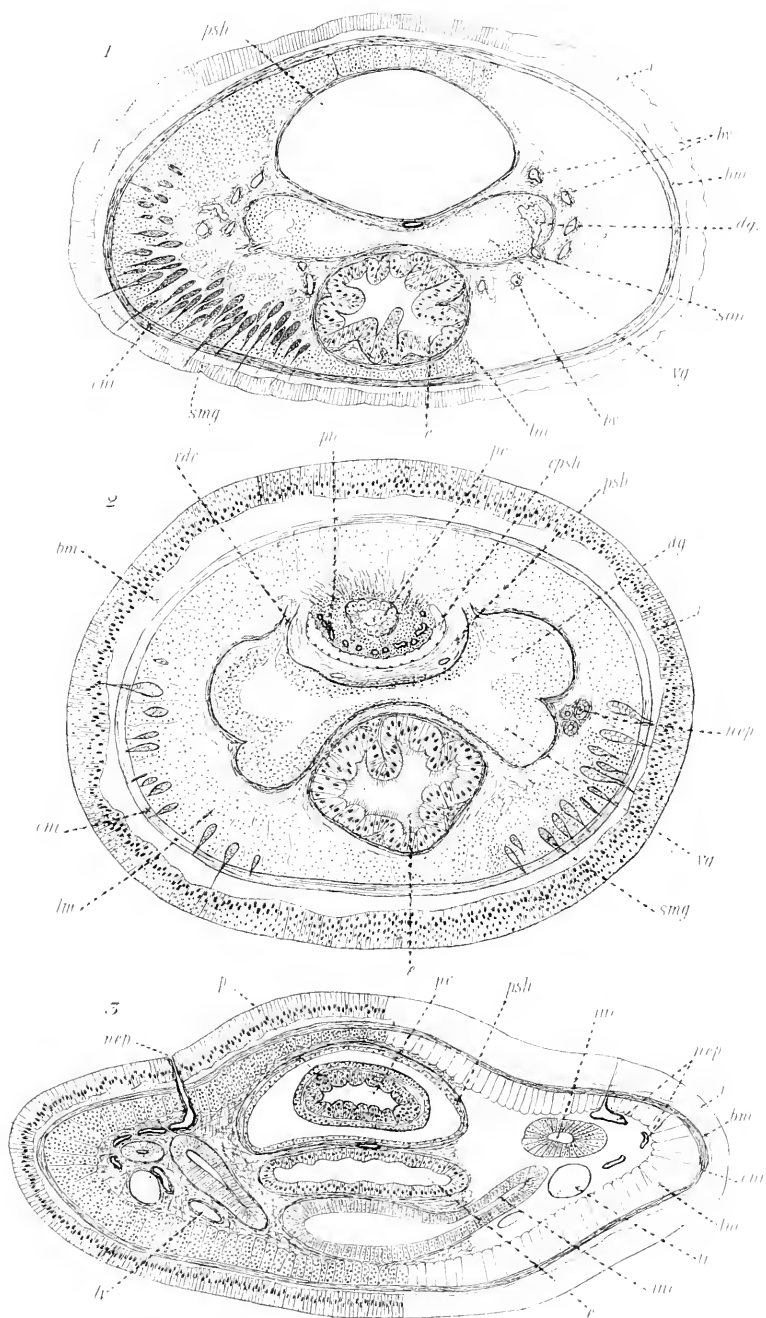


PLATE XII.

FIG. 1. *Parancmerites pallida*. Transverse section through nephridial region.

In this case the single pair of efferent nephridial ducts (*ncp*) was so symmetrically placed that both were cut in a single section. The very small size of the proboscis (*ps*) in the large proboscis sheath (*psb*) is remarkable. The intestinal caecum (*ic*) shows lateral diverticula above the lateral nerve cords. ($\times 18$).

2. *Amphiporus bimaculatus*. Transverse section of proboscis. The 16 proboscis nerves (*pn*) are very sharply defined. The cylindrical plexus (*np*) of nerve fibers and connective tissue serves to connect the nerves, and divides the thick longitudinal muscular band into an inner (*plm*) and an outer (*plm'*) layer. The inner longitudinal muscular layer, found in most related species, is wanting—the basement layer (*bm*) of the internal epithelium (*p:p*) lying immediately beneath the circular muscular layer. ($\times 66$).
3. *Emplectonema bürgeri*. Transverse section through body, showing manner in which the esophagus (*e*) opens into dorsal wall of intestine (*in*). This section also shows the genital pouches (*gp*) lying both above and below the intestinal lobes, and indicating that they open respectively on the dorsal and ventral surfaces of the body. Of the submuscular glands (*smg*), which extend throughout the esophageal region in great abundance but a few remain as far back as the position of the section figured. ($\times 20$).

(108)

PLATE XIII.

- FIG. 1.** *Micrura alaskensis*. Transverse section through mouth region. The peculiar accessory buccal glands (*bg'*) are seen to lie outside the circular muscular layer (*cm*), and amongst the fibers of the outer longitudinal muscular layer (*olm*). Their secretion passes through the layer of circular muscles, and mixes with that of the true buccal glands (*bg*), which lie immediately beneath the epithelium of the mouth (*mep*). The buccal nerves (*bn*) lie on the lateral borders of the mouth as usual. Other reference letters are explained on p. 83. ($\times 30$).
2. *Zygonemertes thalassina*. Transverse section immediately back of the brain. The intestinal cæca (*ic*) reach forward to abut against the dorsal ganglia. The ocelli (*oc*) extend back of the brain, and occupy positions, as shown, immediately above and external to the lateral nerve cords (*ln*). ($\times 100$).
3. *Amphiporus angulatus*. Transverse section through posterior end of body. The drawing is slightly diagrammatic, as it contains portions of the two adjacent sections. The anastomosis of the three longitudinal blood vessels (*bva*) is seen to lie immediately dorsal to the commissure (*nc*) of the lateral nerves (*ln*); the basement layer (*bm*) is remarkably thick in this region. The posterior end of the intestine (*in*) opens ventrally a few sections farther back. Other reference letters are explained above. ($\times 80$).

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MAMMALS COLLECTED BY DR. W. L. ABBOTT
ON THE NATUNA ISLANDS.

BY GERRIT S. MILLER, JR.

ABOUT three months during the spring and summer of 1900 were spent by Dr. W. L. Abbott in exploring the Natuna Islands in the South China Sea.¹ Specimens were collected at the following localities: Pulo Midei, or Low Island (May 23-26), Pulo Seraia (May 29), Sirhassen Island (June 1-10), Pulo Subi (June 12-13), Pulo Lingung (June 17-19), Bunguran, or Great Natuna Island (June 24-July 31) and Pulo Laut, or North Natuna Island (August 5-13). About 265 mammals were obtained, all of which have been presented to the United States National Museum. This paper contains an account of these, and is published here by permission of the Secretary of the Smithsonian Institution.

Two extensive collections of mammals had been made on the Natuna Islands previous to Dr. Abbott's visit, the first by Mr. A. Everett during September and October, 1893, the second by Mr. Ernest Hose during July, August, September and October, 1894. These have formed, either wholly or in part, the basis of several papers,² which constitute the literature relating to

¹For location of the Natuna Islands see Proc. Washington Acad. Sci., II, p. 204. August 20, 1900.

²Thomas (O.) and Hartert (E.). List of the first collection of mammals from the Natuna Islands. *Novitates Zoologicae*, I, pp. 652-660. September, 1894.

Thomas (O.). Revised determinations of three of the Natuna rodents. *Novitates Zoologicae*, II, pp. 26-28. February, 1895.

the mammals of the islands.¹ Twenty-eight land mammals have been recorded as actually represented by specimens, though several others are mentioned which the collectors ascertained to occur. Dr. Abbott secured forty-four species, but failed to obtain seven² of those previously taken. The total number of mammals collected on the islands thus becomes fifty-one. This increase is due, in part to the recognition of a larger number of insular forms than has been admitted by previous writers, but also to a considerable extent to the actual addition of species not hitherto taken. Species new in the latter sense are distinguished in the present paper by absence of reference to previous records.

In regard to the faunal relationships of the Natunas, whether predominantly Bornean or Peninsular, about which much has been written,³ it may be said that this collection, together with much of the other work recently done by Dr. Abbott, tends to show that there is greater general uniformity in the mammalian fauna of Borneo, the Malay Peninsula, and the intervening islands than has been hitherto supposed. It seems unprofitable therefore to offer conjectures as to the probability of greater nearness of the Natuna mammals as a whole to those of Borneo or to those of the Malay Peninsula.

Thomas (O.) and Hartert (E.). On a second collection of mammals from the Natuna Islands. *Novitates Zoologicae*, II, pp. 489-492. December, 1895.

Bonhote (J. Lewis). On the squirrels of the *Ratufa* (*Sciurus*) bicolor group. *Ann. and Mag. Nat. Hist.*, 7th ser., v, pp. 490-499. June, 1900.

Thomas (O.). The red flying squirrel of the Natuna Islands. *Novitates Zoologicae*, VII, p. 592. December 8, 1900.

Bonhote (J. Lewis). On the Squirrels of the *Sciurus Prevostii* Group. *Ann. and Mag. Nat. Hist.*, 7th ser., VII, pp. 167-177. February, 1901.

¹ Gray's "Notice of a species of *Tupaia* from Borneo, in the collection of the British Museum" in the Proceedings of the Zoological Society of London for 1865 (p. 322) may be added to the bibliography of Natuna mammals, as the animal described, though supposed to have been taken in Borneo, is apparently confined to Bunguran Island, the largest of the Natunas.

² *Megaderma spasma*, *Myotis muricola*, *Taphozous melanopogon*, *Mydaus meliceps*, *Paradoxurus hermaphroditus*, *Lutra sumatrana* and *Mus ephippium*.

³ See papers already cited, also *Novitates Zoologicae*, I, p. 468 (letter from Mr. Everett); *ibid.*, I, p. 483 (note on land shells by Mr. E. Smith), *ibid.*, II, p. 478 (Birds); *ibid.*, II, p. 499 (Reptiles).

MANIS JAVANICA Desmarest.

1895. *Manis javanica* THOMAS and HARTERT, Novitates Zoologicae, II, p. 492. December, 1895 (Bunguran).

An adult male was taken on Bunguran, June 24, 1900. Total length 914; head and body 508; tail 406.

TRAGULUS BUNGURANENSIS sp. nov.

Type.—Adult male (skin and skull) No. 104604 U. S. National Museum. Collected on Bunguran Island, North Natunas, July 9, 1900. Original number, 547.

Characters.—Color pattern essentially as in *Tragulus nigricans* Thomas, from Balabac. Size equal to that of *T. canescens* from the Malay Peninsula, therefore much greater than in the Balabac animal.

Color.—Back uniform ochraceous, fading to buff on sides, the hairs everywhere gray at base. Both back and sides everywhere darkened by black hair tips, but these never sufficiently abundant to produce a dark shading in excess of the ochraceous. The relative proportion of the dark wash to the light under color is precisely the same as in *Tragulus canescens* and *T. napu* (from Linga Island) but the black is less conspicuous than in the Bornean form of *T. napu*. Legs, except white area on inner side, like back but slightly brighter and less shaded with black. Entire dorsal and lateral surface of neck clear black to base of hairs, a few ochraceous specks visible on close scrutiny, particularly at sides near throat markings. On shoulders this black area fades abruptly into color of back; on head it passes forward between ears and eyes nearly to muzzle. Cheek, region between eye and ear, and line extending forward over eye to muzzle and separating black median stripe from naked loreal space, ochraceous, essentially like that of legs. Throat markings as in *Tragulus nigricans*, but white stripes apparently even more restricted. Region occupied by posterior white stripes black, continuous with that of neck, but distinctly speckled with ochraceous. Region occupied by anterior stripes ochraceous, continuous with that of cheeks and somewhat less pure and more speckled with black. White stripes as follows: (*a*) One on each side of naked chin area. These are about 50 mm. in length and never more than 10 mm. in breadth, but occasionally so narrow as to break up into two or more spots. They are separated from naked chin patch by an ochraceous stripe slightly broader than the white. Chin area narrowly and discontinuously bordered with white, especially in front. (*b*) Two posterior lateral stripes varying

from 50 mm. to 80 mm. in length, and never more than 12 mm. wide. They are strongly convergent anteriorly, and sometimes nearly joined together in front by a median spot. These white stripes are always separated from the anterior stripes by an ochraceous median area varying from 10 mm. to 25 mm. in width. (c) A median stripe lying between the posterior lateral stripes. Posteriorly this stripe is as wide as the lateral stripes, but it quickly narrows and sometimes disappears at middle of latter, though usually represented again by the median spot already referred to. In none of the specimens is this stripe broad and continuous anteriorly to level of front of lateral stripes as in Nehring's figure of the throat markings of *T. nigricans*.¹ Collar narrow, ochraceous grizzled with black. It is seldom more than 25 mm. in width; therefore much narrower than indicated by Nehring's figure. Behind the collar is a whitish gray median area continuous laterally with narrow light stripe down inner side of fore legs. This light area is sometimes divided by a dark median line joining collar with buff of belly. Belly and chest buff, essentially like that of sides, with which it forms no contrast in color. As on the sides the buff is clouded by black hair tips, but the hairs are scarcely if at all gray at base. On chest the dark hair tips tend to form a median stripe, which is sometimes sharply defined and continuous with the ochraceous line occasionally dividing white of breast. A clear whitish area slightly larger and better defined than that of breast occupies region between hind legs. It is continuous with white stripe down inner side of hind legs. This stripe is usually divided on thigh by encroachment of the surrounding ochraceous. Tail silky white below and at tip, essentially like back above.

Skull.—The skull of *Tragulus bunguranensis* fully equals that of *T. canescens* in size, and distinctly exceeds that of the Bornean form of *T. napu*. It is much larger than that of *T. nigricans*, which proves to be a medium sized species like *T. rufulus*. In general form the skull agrees so closely with that of *Tragulus canescens* that it is only to be distinguished by its slightly greater relative breadth and smaller, less inflated audital bullæ. As compared with the skull of *Tragulus nigricans*,² that of *T. bunguranensis* is much larger (distance from back of occiput to front of canine 103 instead of 92, zygo-

¹ Sitz.-Berich. der Gesellsch. Naturforschender Freunde zu Berlin, 1893, p. 224.

² For the opportunity of examining the skull of an adult male from Balabac I am indebted to the courtesy of Mr. D. G. Elliot. A photograph (slightly reduced) of this specimen was published by Mr. Elliot in 1896 (Field Columbian Museum, Publication 11, Zoological Series, 1, No. 3, pl. XI, May, 1896).

matic breadth 53 instead of 45), and the braincase is more conspicuously ridged for muscular attachment. That part of the braincase immediately above posterior root of zygoma is more conspicuously inflated. Otherwise I can detect no salient differences in the skulls of the two animals.

Teeth.—The teeth are uniformly larger than those of *Tragulus nigricans*, but in form they present no characters of importance. As compared with *T. canescens* the premolars both above and below are conspicuously more robust, a character in which the Bunguran animal agrees with the Bornean form of *Tragulus napu*.

Measurements.—External measurements of type: total length 647; head and body 571; tail vertebrae 76; hind foot 146; hind foot without hoofs 128. Average and extremes of five adults from the type locality: total length 643 (628–673); head and body 566 (558–584); tail vertebrae 77 (70–89); hind foot 142 (140–146); hind foot without hoofs 126 (124–128).

Cranial measurements of type: greatest length 114; basal length 107; basilar length 100; occipito-nasal length 106; length of nasals 32; diastema 13 (9);¹ zygomatic breadth 52 (46); least interorbital breadth 33 (28); greatest breadth of braincase above base of zygomata 38 (33); mandible 91 (78); maxillary toothrow (alveoli) 38 (34); mandibular toothrow (alveoli) 44 (39); anterior upper premolar 7×3.8 (6.4×3); middle lower premolar 7.2×3 (5.8×2.4).

Weight.—Weight of type 3.8 kg.; of two other males 3.6 kg. each. Two adult females weigh respectively 3.6 kg. and 4.2 kg.

Specimens examined.—Six, all from the type locality.

Remarks.—*Tragulus bunguranensis* is so distinct from the other known species as to require no detailed comparisons.

TRAGULUS sp.

Two specimens from Sirhassen Island are too immature for determination. Apparently they represent a member of the *napu* group, allied to that occurring in Borneo. The throat markings show no approach to those of *Tragulus bunguranensis*.

TRAGULUS JAVANICUS (Gmelin).

1894. *Tragulus javanicus* THOMAS and HARTERT, Novitates Zoologicae, I, p. 660. September, 1864 (Bunguran).

1895. *Tragulus javanicus* THOMAS and HARTERT, Novitates Zoologicae, II, p. 492. December, 1895 (part, specimens from Bunguran).

Six specimens from Bunguran.

¹Measurements in parentheses are those of an adult male topotype of *Tragulus nigricans*.

TRAGULUS PALLIDUS sp. nov.

1895. *Tragulus javanicus* THOMAS and HARTERT, *Novitates Zoologicae*, 11, p. 492. December, 1895 (part, specimen from Pulo Laut).

Type.—Adult female (skin and skull) No. 104616 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 11, 1900. Original number 625.

Characters.—Smaller than *Tragulus javanicus* from Borneo or Bunguran and very pale in color. Black clouding of upper parts inconspicuous, but dark nape band well defined.

Color.—Back and sides light ochraceous-buff everywhere clouded by the blackish hair-tips, but these never in excess, except perhaps along middle of back and across lumbar region. Flanks, shoulders, neck, outer surface of legs and narrow line dividing color of sides from that of belly pale ochraceous. Nape band clear black, sharply defined from color of sides but quickly fading into that of shoulders. Top of head dull dark brown. A faint pale stripe over and in front of eye. Throat markings normal, the dark bands like neck. Collar very narrow. Under parts and inner surface of legs white. A faint yellowish shade along middle of belly. Tail white beneath and at the tip, ochraceous faintly shaded with brown above.

Skull.—The skull of the type, though fully adult and with all the teeth distinctly worn, is smaller than in Bunguran specimens so young that the posterior molars are still below the rim of the alveoli. In form, however, it shows no marked peculiarities, though in general it appears to be somewhat broader in proportion to its length than that of the Bunguran animal.

Teeth.—Teeth as in specimens of *Tragulus javanicus* from Bunguran except that the premolars, both above and below, are shorter and broader, a difference which may prove to be an individual peculiarity only.

Measurements.—External measurements of type: Total length 539; head and body 444; tail vertebrae 95; hind foot 107; hind foot without hoofs 95.

Cranial measurements of type: Greatest length 90 (94¹); basal length 83 (87); basilar length 78 (82); occipito-nasal length 83 (89); length of nasals 25 (29.6); diastema 9.2 (9.8); zygomatic breadth 41.4 (40); least interorbital breadth 26.4 (25); breadth of braincase over roots of zygomata 29.4 (28.4); mandible 72 (75);

¹ Measurements in parentheses are those of a less mature specimen from Bunguran.

maxillary toothrow (alveoli) 31.6 (34); first upper premolar 6.4×2.8 (7×2.6); mandibular toothrow (alveoli), 35.8 (38).

Specimens examined.—One, the type.

Remarks.—This is a pallid form of *Tragulus javanicus*, a species which apparently shows very little tendency to become differentiated into local races. The characters of the Pulo Laut animal were pointed out by Thomas and Hartert in 1895.

SUS NATUNENSIS sp. nov.

1894. *Sus* sp. THOMAS and HARTERT, Novitates Zoologicae, I, p. 660. September, 1894 (Bunguran).

1895. *Sus* sp. THOMAS and HARTERT, Novitates Zoologicae, II, p. 492. December, 1895 (Bunguran).

Type.—Adult female (skin and skull) No. 104856 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 6, 1900. Original number 609.

Characters.—Externally much like the Tenasserim form of *Sus cristatus*, but smaller; body brownish in marked contrast with black legs and face; skull conspicuously shorter and broader.

Fur.—The fur throughout consists of bristles with no admixture of softer hairs. The bristles are everywhere less stiff than in the Tenasserim pig, but the difference is most noticeable in the mane, which, though well developed (about 80 mm. in length), is composed of bristles very slightly coarser than those of the surrounding parts, and of not more than half the diameter of the corresponding hairs in females of *S. cristatus*. Muzzle, chest, belly and ears nearly bare.

Color.—General color black, clear and unmixed with brown on legs, throat, and face, but elsewhere heavily overlaid with brownish buff, particularly on back and sides. The brownish wash ceases abruptly just in front of ears, leaving the face and cheeks clear black. A conspicuous dull buff streak 100 mm. long and about half as wide at middle extends back from angle of mouth to level of posterior canthus of eye. It is sharply outlined above by black of cheeks, and below by that of chin. A faint buffy mark beneath eye. Tail like back.

Skull.—The skull while much shorter than that of *Sus cristatus* from Tenasserim is actually broader. As a result the width across postorbital processes is contained only about three times in occipito-nasal length, as opposed to nearly four times in the related species. Similarly the zygomatic breadth slightly exceeds one half of the basilar length, while in *Sus cristatus* it is less than half. Width of pal-

ate between middle molars almost exactly one sixth distance from posterior edge of palate to front of premaxillaries (measured along median line). In *Sus cristatus* the palatal width is contained nearly seven times in the same distance. Dorsal profile of skull slightly concave near base of nasals. Zygomata heavier and deeper than in *Sus cristatus*. Audital bullæ noticeably smaller and less inflated than in the Tenasserim pig. Mandible shorter and much more robust than that of *Sus cristatus*, the outward bulge of the ramus a little behind middle of toothrow greatly accentuated.

Teeth.—As the teeth of the two specimens of *Sus natunensis* are much worn, while those of the only skulls of *Sus cristatus* at hand are not fully grown, it is impossible to make any accurate comparisons. The smaller size of the Natuna pig's teeth is, however, evident for the length of the entire upper toothrow does not equal that of *S. cristatus* without the posterior molar. The crown of the middle upper molar appears to be more nearly square in outline than that of the Tenasserim pig, but in the very different condition of the specimens it would be unsafe to assume that this character is constant.

Measurements.—External measurements of type; total length 1294; head and body 1117; tail vertebrae 177; height at shoulder 558; hind foot 220 (170); ear from meatus 100; width of ear 75.

Cranial measurement of type: greatest length 295 (332¹); occipito-nasal length 282 (316); basal length 245 (275); basilar length 235 (263); length of nasals 135 (157); width of both nasals together posteriorly 34 (33); median length of bony palate 168 (183); width of bony palate at middle of second molar 30 (29); breadth between tips of postorbital processes 87 (87); least interorbital breadth 64 (65); zygomatic breadth 130 (133); occipital breadth 58 (62); occipital depth 100 (103); least depth of rostrum between canine and incisor 33 (39); mandible 225 (232); depth of mandible through coronoid process 104 (110); depth of ramus at front of first molar 40 (41); maxillary toothrow to front of canine (alveoli) 113 (131²); mandibular toothrow to front of canine (alveoli) 120 (138); crown of first upper molar 12 × 13 (18 × 16); crown of second upper molar 18 × 18 (22 × 16).

Weight.—Weight of type, 40 kg.; weight of adult female from Pulo Lingung, 35 kg.

Specimens examined.—Two, one from Pulo Laut, the other from Pulo Lingung.

¹ Measurements in parentheses are those of a Tenasserim specimen (female) of *Sus cristatus* so young that the posterior molar is not fully in place.

² Last molar not fully grown.

Remarks.—While the two specimens agree in all essential characters they differ in numerous minor details. The skin from Pulo Lingung is somewhat darker than the type, but the difference is due to the shade of the brown wash, not to any extension of the black. The skull of this specimen is more rounded posteriorly than that of the type, and the rostrum is shorter. Both specimens show conclusively that their relationships are with the *Sus cristatus* of the Malay Peninsula and not with the *S. longirostris* of Borneo, a case which finds an exact parallel in the giant squirrels.

MUS INTEGER sp. nov.

Type.—Adult male (skin and skull) No. 104837 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 7, 1900. Original number 455.

Characters.—A large robust species with coarse but not spinous fur. Relationships with *Mus validus* Miller, from Trong, Lower Siam, and *Mus mülleri* Jentink from Sumatra. Differs from the former in smaller size and in the absence of the anterior outer tubercle of the last upper molar, and from the latter in larger size, and yellowish brown (not white) underparts.

Color.—Back and sides a fine grizzle of black and dull ochraceous (the exact shade intermediate between the ochraceous and ochraceous-buff of Ridgway), the two colors nearly equally mixed on back, but the ochraceous in excess on sides. Underparts and inner surface of legs buff. An ill defined drab-gray median line from throat to pubic region. Head darker and more glossy than back, the cheeks distinctly washed with gray. Lips and chin drab-gray. Feet an indefinite brown, darker on metapodials. Ears essentially naked, dark brown. Tail dark brown throughout. Underfur gray (Ridgway, pl. II, No. 8), becoming paler on under parts where it fades irregularly into the general buff.

Fur.—The fur is exactly as in *Mus validus*, that is the grooved bristles are so slender that their true nature is not apparent without use of lens. On middle of back the mass of the fur is about 17 mm. in length, the long terete hairs scattered through it reaching about 30 mm. On rump the fur is longer but not conspicuously so, and there is no noticeable increase in length or abundance of the terete black hairs.

Tail, feet and mammae.—Tail slightly more coarsely scaled than in *Mus validus*; 9 rings to the centimeter at middle. Hairs scarcely noticeable except toward tip, where they somewhat exceed the breadth of the rings.

Feet heavy and robust. Thumb short, with a flat blunt nail. Soles and palms naked, the former with six well developed tubercles, the latter with five.

Mammæ, p. 2 — 2, i 2 — 2 = 8.

Skull.—In general appearance the skull of *Mus integer* resembles that of *Mus validus*.¹ It is shorter (greatest length about 51 instead of 55) and the rostrum is relatively broader and deeper. Audital bullæ similar in form to those of *Mus validus*, but the surface less irregular. Region between anterior bases of zygomata broader than in *Mus validus* so that the arches are more nearly parallel.

Teeth.—The teeth are relatively as well as actually smaller than in *Mus validus* and the enamel pattern is normal, that is, the posterior upper molar consists of two transverse folds, and an anterior internal tubercle. There is no trace of the supplementary outer tubercles of the corresponding tooth of *Mus validus*.

Measurements.—External measurements of type: total length 463; head and body 235²; tail vertebræ 228²; hind foot 48 (45); ear from meatus 19; ear from crown 15; width of ear 15. In adult male topo-type: total length 462; head and body 234; ²tail vertebræ 228; ²hind foot 46 (44); ear from meatus 21; ear from crown 16; width of ear 16.

Cranial measurements of type: greatest length 52 (55);³ basal length 45 (48.6); basilar length 41.6 (45.6); palatal length 23 (26); least width of palate between anterior molars 5 (5); diastema 14 (14.6);⁴ length of incisive foramen 8 (9) combined breadth of incisive foramina 3 (3.6); length of nasals 21 (22.6); combined breadth of nasals 6 (6.2); zygomatic breadth 25 (28); interorbital breadth 8 (8); mastoid breadth 19 (19); breadth of braincase above roots of zygomata 18.8 (20); depth of braincase at anterior border of basi-occipital 12.8 (15); frontopalatal depth at posterior extremity of nasals 12.8 (13.4); least depth of rostrum immediately behind incisors 10 (10); maxillary toothrow (alveoli) 9.6 (11); width of front upper molar 3 (3); mandible 30 (31); mandibular toothrow (alveoli) 9 (10).

Specimens examined.—Four, three from the type locality, and one from Pulo Lingung.

Remarks.—This rat is probably a near relative of the Bornean *Mus mülleri* of Thomas.⁵ The specimen from Pulo Lingung does not differ appreciably from the others.

¹ See Proc. Biol. Soc. Washington, XIII, Pl. III and IV.

² Collector's measurement.

³ Measurements in parentheses are those of the type of *Mus validus*.

⁴ In the type of *Mus mülleri* the diastema is 12 mm.

⁵ Ann. and Mag. Nat. Hist., 6th ser., XIV, p. 450. December, 1894.

MUS SABANUS Thomas.

1887. *Mus sabanus* THOMAS, Ann. and Mag. Nat. Hist., 5th ser., xx, p. 270. October, 1887 (Mt. Kina Balu, Borneo).
 1894. *Mus sabanus* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 658. September, 1894 (Bunguran).

Thirteen skins and one extra skull, all from Bunguran. There is little probability that this rat is the same as the true *Mus sabanus* of Borneo.

MUS RAJAH Thomas.

1894. *Mus hellwaldi* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 658. September, 1894 (Bunguran).
 1894. *Mus rajah* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., xiv, p. 451. December, 1894 (Mount Batu Song, Borneo).
 1895. *Mus rajah* THOMAS, Novitates Zoologicae, 11, p. 26. February, 1895 (Revised determination of Bunguran specimens).

Six specimens (one in alcohol) from Bunguran, two from Pulo Lingung, one from Pulo Laut, four (one in alcohol) from Sirhassen, and one (in alcohol) from Pulo Midei. It is doubtful whether these series are referable to one species or whether any of them are the true Bornean *Mus rajah*. The material is not wholly satisfactory, and I have been unable to examine specimens from Borneo.

MUS NEGLECTUS Jentink.

1894. *Mus rattus* var. THOMAS and HARTERT, Novitates Zoologicae, 1, p. 658. September, 1894 (Bunguran).
 1895. *Mus neglectus* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 492. December, 1895 (Bunguran).

Five specimens from Pulo Lingung, one from Pulo Midei, and nine from Sirhassen. In the absence of Bornean material, I follow Thomas and Hartert in referring the Natuna rats of the '*alexandrinus*' type to *Mus neglectus*.

SCIUROPTERUS EVERETTI Thomas.

1894. *Sciuropterus phayrei* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 660. September, 1894 (Bunguran).
 1895. *Sciuropterus everetti* THOMAS, Novitates Zoologicae, 11, p. 27. February, 1895 (Revised determination of Bunguran specimens).
 1895. *Sciuropterus everetti* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 490. December, 1895 (Bunguran).

Two specimens, both from Bunguran; an immature male taken July 4, and an adult female taken July 21, 1900.

PETAURISTA NITIDULA Thomas.

1894. *Pteromys nitidus* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 660. September, 1894 (Bunguran).

1895. *Pteromys nitidus* THOMAS and HARTERT, Novitates Zoologicae, II, p. 490. December, 1895 (Bunguran).
1900. *Petaurista nitidula* THOMAS, Novitates Zoologicae, VII, p. 592. December 8, 1900 (Bunguran).

Seven specimens from Bunguran.

SCIURUS PROCERUS sp. nov.

1894. *Sciurus tenuis* THOMAS and HARTERT, Novitates Zoologicae, I, p. 659. September, 1894 (Bunguran).
1895. *Sciurus tenuis* THOMAS and HARTERT, Novitates Zoologicae, II, p. 492. December, 1895 (Bunguran).

Type.—Adult male (skin and skull) No. 104698 U. S. National Museum. Collected on Bunguran Island, North Natunas, July 18, 1900. Original number 574.

Characters.—Externally similar to *Sciurus tenuis* though somewhat smaller. Skull very much smaller and relatively broader than in the related species.

Color.—The color is exactly like that of *Sciurus tenuis* from Singapore.

Skull and teeth.—Except that it appears to be broader throughout, relatively to its length, the skull of *Sciurus procerus* is essentially a miniature of that of *S. tenuis*, as the braincase shows none of the tendency to increased depth characteristic of the Bornean animal. Ratio of rostral depth to distance between middle of interparietal and lower rim of audital bulla, 50. This ratio is 49 in *S. tenuis*.

Measurements.—External measurements of type: total length 235; head and body 140; tail vertebrae 95; hind foot 35 (33). Average and extremes of four specimens from the type locality: total length 239.5 (235–247); head and body 140; tail vertebrae 99.5 (95–107); hind foot 35.2 (34–36.5); hind foot without claws 32.9 (31.8–34).

Cranial measurements of type: greatest length 34 (38);¹ basal length 28.6 (32); basilar length 26 (29); palatal length 14.6 (16); diastema, 7.6 (8.8); length of nasals 10.4 (11.4); greatest breadth of nasals 4.8 (5.6); interorbital breadth 12 (12.6); zygomatic breadth 20.8 (21); greatest breadth of braincase 17 (17.6); cranial depth from middle of interparietal to lower rim of audital bulla 14 (15); least depth of rostrum 7 (7.2); mandible, 20 (21); maxillary toothrow (alveoli) 6 (7); mandibular toothrow (alveoli), 6 (7).

Specimens examined.—Six, all from the type locality.

Remarks.—This species is immediately distinguishable from its

¹Measurements in parentheses are those of an adult male topotype of *Sciurus tenuis*.

allies by its small skull, scarcely larger than that of *Funambulus maccllellandi*.

SCIURUS NATUNENSIS (Thomas).

1894. *Sciurus lowi* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 659. September, 1894 (Sirhassen).
 1895. *Sciurus lowi natunensis* THOMAS, Novitates Zoologicae, 11, p. 26. February, 1895 (Revised determination of Sirhassen specimen).
 1895. ? *Sciurus lowi natunensis* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 491. (Bunguran and Pulo Laut.)

Four specimens from Sirhassen. The average and extreme measurements are as follows: total length 222 (215-229); head and body 135 (133-140); tail vertebrae 86 (82-89); hind foot 33.6 (33-35); hind foot without claw 31.5 (30.5-32).

SCIURUS LINGUNGENSIS sp. nov.

1895. ? *Sciurus lowi natunensis* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 491. (Bunguran and Pulo Laut.)

Type.—Adult male (skin and skull) No. 104693 U. S. National Museum. Collected on Pulo Lingung off southern extremity of Bunguran, North Natuna Islands, June 19, 1900. Original number 494.

Characters.—Externally similar to *Sciurus natunensis* (Thomas), but slightly larger (hind foot with claws 36 instead of 33.6). Skull larger than that of *S. natunensis*, the audital bullae much broader anteriorly.

Color.—The color is precisely as in *Sciurus natunensis*, and therefore requires no detailed description.

Skull.—Skull larger than that of *Sciurus natunensis* (see measurements) but not different in general form. The audital bullae are, however, readily distinguishable by the much greater development of the anterior inner lobe. In *Sciurus natunensis* this lobe is so small as scarcely to form any part of the general contour of the bulla. In *S. lingungensis* it is nearly equal to the anterior outer lobe, together with which it imparts a distinctly triangular outline to the ventral aspect of the bulla.

Measurements.—External measurements of type: total length 229; head and body 140; tail vertebrae 89; hind foot 36 (33.7); ear from meatus 12; ear from crown 7. A second specimen from the type locality gives precisely the same measurements.

Cranial measurements of type: greatest length 38 (36);¹ basal length 33 (31); basilar length 30 (29); palatal length 17 (16); greatest

¹ Measurements in parentheses are those of an older specimen of *Sciurus natunensis* from Sirhassen.

length of nasals 11 (10); greatest width of both nasals together 5 (5); interorbital breadth 12 (11.4); zygomatic breadth 22.4 (20); mastoid breadth 17 (16.6); depth of braincase at anterior edge of basi-occipital 13.6 (13); mandible 23 (22); maxillary tooththrow (alveoli) 6.4 (7); mandibular tooththrow (alveoli) 7 (7).

Specimens examined.—Two, both from the type locality.

Remarks.—While *Sciurus lingungensis* is scarcely distinguishable from *S. natunensis* by external characters alone, size of the skull and form of the audital bullæ are clearly diagnostic. Both species from the Natunas are separated from the Bornean *S. loewi* Thomas by their well developed ears, and shorter broader rostral portion of skull.

SCIURUS LUTESCENS sp. nov.

1894. *Sciurus notatus* THOMAS and HARTERT, Novitates Zoologicæ, 1, p. 659. September, 1894 (part, specimens from Sirhassen).

Type.—Adult male (skin and skull) No. 104668 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 3, 1900. Original number 429.

Characters.—Allied to *Sciurus notatus*, but considerably smaller than the Bornean representative of the species. Colors very pale, the under parts buff or cream-buff (Ridgway, pl. v, nos. 13 and 11) irregularly tinged with gray.

Color.—Entire dorsal surface of body and tail a fine grizzle of black and cream-buff, the individual hairs black with two or three cream buff rings. On tail the grizzle is less fine than on back, and it shows a faint tendency to resolve itself into obscure cross bands. On sides of body and on head the cream-buff brightens to buff. Cheeks and muzzle buff, scarcely grizzled. Feet slightly yellower than sides, under parts and inner surface of legs pale buff, palest anteriorly and laterally (where it about matches the cream-buff of Ridgway) brightest along median line. Under side of tail dull ochraceous-buff slightly grizzled with black. Pencil not different from rest of tail. Between the colors of sides and belly are the usual longitudinal stripes. The outer of these is about 5 mm. in width, and cream-buff in color. The inner is about twice as wide, and black, but much obscured by a thick sprinkling of bluish gray hairs. Outer surface of ears concolor with neck, inner surface like cheeks. The sprinkling of bluish gray hairs on sides of belly extends irregularly forward to axilla and inner side of front leg, occasionally to throat and chin.

Skull.—As compared with the Bornean form of *Sciurus notatus*, the skull of *S. lutescens* is much smaller (greatest length about 45 in-

stead of 50) the rostrum is relatively shorter and broader, and the audital bullæ are less elongate antero-posteriorly. Teeth as in *Sciurus notatus* except that they are uniformly smaller.

Measurements.—External measurements of type: total length 355; head and body 177; tail vertebræ, 177; hind foot 45 (41). Average and extremes of six specimens from the type locality: total length 356 (329–375); head and body 186 (177–196); tail vertebræ 170 (152–178); hind foot 43.8 (41–45); hind foot without claws 40.7 (39–42).

Cranial measurements of type: greatest length 45.4 (50.4)¹; basal length 39 (43); basilar length 36.4 (41); palatal length 20 (23); palatal width between middle molars 6 (6); greatest length of nasals 13 (14.8); greatest width of both nasals together 6.6 (7); interorbital breadth 15.4 (17); mastoid breadth 21 (21); zygomatic breadth 26 (29); depth of braincase at anterior edge of basi-occipital 16 (16.8); mandible 28 (30); maxillary toothrow (alveoli) 8 (9); mandibular toothrow (alveoli) 8 (9).

Specimens examined.—Seven (one in alcohol), all from the type locality.

Remarks.—This squirrel is recognizable among the members of the *S. notatus* group by its light colors, and particularly by the pallor of the under parts. In the latter characteristic it is approached by the form inhabiting Pulo Laut, but with this exception it is unique among the fulvous bellied species. The six specimens show no variation worthy of note.

SCIURUS SERALÆ sp. nov.

Type.—Adult male (skin and skull) No. 104660 U. S. National Museum. Collected on Pulo Seraia, South Natuna Islands, May 29, 1900. Original number 415.

Characters.—Most nearly related to the small, pallid, *Sciurus lutescens* from Sirhassen Island, but upper parts slightly less pale, and under parts and pale side stripe buff-yellow, the former without admixture of gray.

Color.—Upper parts as in *Sciurus lutescens* except that the pale bands on the hairs are more nearly buff than cream-buff. Tail essentially as in *S. lutescens* but a shade less pale. Under parts buff-yellow darkening irregularly to dull orange-buff. Dark side stripe broad and well defined.

Skull.—The skull closely agrees with that of *Sciurus lutescens* in

¹Measurements in parentheses are those of an adult *Sciurus notatus* from Borneo.

both size and form, though it is perhaps even broader in proportion to its length. Teeth as in *S. lutescens*.

Measurements.—External measurements of type: total length 368; head and body 197; tail vertebrae 171; hind foot 44 (40). Average and extremes of four specimens from the type locality: total length 347 (323–368); head and body 184 (171–197); tail vertebrae 163 (152–171); hind foot 43.7 (43–45); hind foot without claws 40.1 (39.5–41).

Cranial measurements of type: greatest length 45; basal length 38.6; basilar length 36; zygomatic breadth 26.4; least interorbital breadth 17; mandible 28; maxillary tooththrow (alveoli) 8.6; mandibular tooththrow (alveoli) 8.6.

Specimens examined.—Four, all from the type locality.

Remarks.—As might be expected from the geographic position of the island it inhabits, *Sciurus seraia* differs from the Bornean *S. notatus* in much the same way as the Sirhassen representative of the group. It is readily distinguishable from the Sirhassen animal by the different color of the under parts. In color *Sciurus seraia* closely resembles *S. abbottii* of the Tambelan Islands. The latter is, however, a much larger animal, with a longer and relatively narrower skull.

SCIURUS RUTILIVENTRIS sp. nov.

Type.—Adult male (skin and skull) No. 104658 U. S. National Museum. Collected on Pulo Midei (Low Island), South Natuna Islands, May 24, 1900. Original number 405.

Characters.—Size slightly greater than that of *Sciurus lutescens* and *S. seraia*, but not equal to that of the Bornean or Bunguran representatives of *S. notatus*. Color above as in *S. seraia*. Under parts bright clear orange-rufous.

Color.—Color exactly as in *Sciurus seraia* except that the pale side stripe is light cream-buff and the under parts are bright orange rufous. Tail without trace of red suffusion.

Skull and teeth.—The skull and teeth are a trifle larger than in *Sciurus lutescens* and *S. seraia*, but the difference is scarcely a tangible one.

Measurements.—External measurements of type: Total length 368; head and body 190; tail vertebrae 178; hind foot 45 (41). Average and extremes of seven specimens from the type locality: total length 356 (330–368); head and body 186 (178–190); tail vertebrae 173 (165–184); hind foot 45.5 (43–48); hind foot without claws 42.2 (39.5–45).

Specimens examined.—Seven, all from the type locality.

Remarks.—This squirrel is remarkable among the Natuna members of the *S. notatus* group for the brilliant color of its under parts. In this respect it surpasses all of the related forms with which I am acquainted. The red color is, however, strictly confined to the body, showing no tendency to spread to the tail as in *S. miniatus* of the Malay Peninsula.

SCIURUS RUBIDIVENTRIS sp. nov.

1894. *Sciurus notatus* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 659. September, 1894 (part, specimens from Bunguran).

1895. *Sciurus notatus* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 491. December, 1895 (part, specimens from Bunguran).

Type.—Adult female (skin and skull) No. 104671 U. S. National Museum. Collected on Bunguran Island, North Natunas, June 22, 1900. Original number 498.

Characters.—Size and general appearance both above and below as in the Bornean form of *Sciurus notatus*, but red of under parts brighter, and cheeks and chin distinctly less fulvous than surrounding parts. Skull with broader, deeper braincase than in the Bornean animal.

Color.—The color so closely resembles that of the Bornean *Sciurus notatus* that no detailed description is necessary. Under parts ochraceous-rufous, fading to tawny on throat, everywhere lighter and more tinged with red than in the Bornean animal. In the latter the color of the under parts extends forward to lips and also strongly suffuses the cheeks and sides of head which are only a shade browner than the throat and conspicuously more fulvous than top of head and sides of neck. In *Sciurus rubidiventris* the cheeks and lips are noticeably suffused with gray so that they form a distinct contrast with both throat, top of head and sides of neck.

Skull.—The skull agrees in general size with that of the Bornean animal, and is therefore much larger than in the three species from the South Natunas. It is distinguishable by greater general breadth and by the depth of the braincase, which perceptibly exceeds that of *S. notatus*.

Measurements.—External measurements of type: total length 380; head and body 209; tail vertebrae 171; hind foot 49 (44.5). Averages and extremes of seven specimens from the type locality: total length 378 (368–393); head and body 208 (203–222); tail vertebrae 173 (165–184); hind foot 49.3 (48–50); hind foot without claws 45.7 (44.5–47).

Cranial measurements of type: greatest length 52.4 (50.4);¹ basal

¹Measurements in parentheses are those of an adult Bornean *Sciurus notatus*.

length 44 (43); basilar length 41 (41); palatal length 23 (23); palatal width between middle molars 6 (6); greatest length of nasals 15 (14.8); greatest width of both nasals together 7.2 (7); interorbital breadth 18.2 (17); mastoid breadth 23 (21); breadth of braincase above roots of zygomata 24 (22); zygomatic breadth 30.4 (29); depth of braincase at anterior edge of basi-occipital 17.8 (16.8); mandible 29 (30); maxillary toothrow (alveoli) 9 (9); mandibular toothrow (alveoli) 9 (9).

Specimens examined.—Seven, all from the type locality.

Remarks.—In both size and general color this squirrel more closely resembles the Bornean representative of the group than it does either of the three forms from the South Natunas. Its relationships, however, appear to be rather with the race inhabiting Singapore Island than with any of its near geographic allies, *Sciurus lautensis* excepted.

SCIURUS LAUTENSIS sp. nov.

1895. *Sciurus notatus* THOMAS and HARTERT, Novitates Zoologicae, 11, p. 491. December, 1895 (part, specimens from Pulo Laut).

Type.—Adult female (skin and skull) No. 104683 U. S. National Museum. Collected on Pulo Laut, North Natuna Islands, August 6, 1900. Original number 612.

Characters.—Size slightly less than that of *Sciurus rubidiventris* and color conspicuously pallid. Upper parts as in *S. lutescens*; lower parts nearly as in *S. seraïæ* but rather less dull; pale side stripe much less yellow than belly. Skull as in *Sciurus rubidiventris*.

Color.—Upper parts and tail as in *Sciurus lutescens*. Cheeks faintly washed with ochraceous-buff. Under parts and inner surface of legs bright ochraceous-buff (distinctly more yellow than Ridgway's pl. V, No. 10). Lateral stripes as in *S. lutescens* (not distinctly yellowish as in *S. seraïæ*), but black band usually less sprinkled with gray. Scarcely a trace of gray in axillary region or on sides of neck.

Skull.—The skull in all respects closely resembles that of *S. rubidiventris* except that it is slightly smaller. Its large size and the correspondingly large teeth readily distinguish it from that of the South Natuna species.

Measurements.—External measurements of type: total length 375; head and body 195; tail vertebræ 180; hind foot 44 (41). Average and extremes of nine specimens from the type locality; total length 363 (355–379); head and body 189 (171–196); tail vertebræ 170 (165–183); hind foot 45 (44–46); hind foot without claws 42 (41–43).

Specimens examined.—Ten (one in alcohol), all from the type locality.

Remarks.—Though suggesting two of the small South Natuna squirrels in color, *Sciurus lautensis* is obviously related to the dark colored Bunguran form, with which it more nearly agrees in size.

SCIURUS NAVIGATOR (Bonhote).

1894. *Sciurus prevostii* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 656. September, 1894 (Sirhassen).

1901. *Sciurus prevostii navigator* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., VII, p. 171. February, 1901 (Sirhassen).

Nine specimens, three from Sirhassen Island and six from Pulo Subi.

Those from Pulo Subi, while agreeing with the topotypes in color, appear to average a trifle smaller, though the series is hardly extensive enough to prove that this is constant.

RATUFA SIRHASSENENSIS (Bonhote).

1894. *Sciurus bicolor albiceps* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 659. September, 1894 (Sirhassen).

1900. *Ratufa ephippium sirhassenensis* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., V, p. 498. June, 1900 (Sirhassen).

Two specimens, Sirhassen, June 8, 1900.

This species, though related to *Ratufa ephippium*, with which it agrees in color-scheme, is sharply differentiated by its small size and cranial peculiarities. It is in no way closely allied to *Ratufa bunguranensis* and *R. nanogigas*.

As compared with that of *Ratufa ephippium sandakanensis* Bonhote, the skull in addition to its small size (greatest length 57 instead of 65) differs in general narrowness, in the relatively greater breadth of the nasal branches of the premaxillaries, and in the form of the audital bullæ. When the skull is held upside down and viewed from behind the bullæ are seen to be narrower than in the Bornean animal and to rise to a much greater height above the surface of the basioccipital.

RATUFA BUNGURANENSIS (Thomas and Hartert).

1894. *Sciurus bicolor bunguranensis* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 658. September, 1894 (Bunguran).

1895. *Sciurus bicolor bunguranensis* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 491. December, 1895 (Bunguran).

1900. *Ratufa ephippium bunguranensis* BONHOTE, *Ann. and Mag. Nat. Hist.*, 7th ser., V, p. 497. June, 1900.

Thirteen specimens from Bunguran, all in various stages of the

change from the bleached winter coat to the summer pelage. In the latter there is some color variation, mostly due to the greater or less distinctness of the drab wash overlying the Prouts-brown or 'chocolate' of the upper parts. Not only does the drab vary in amount in different individuals, but on every specimen it is more noticeable when the animal is viewed from in front. The drab wash is of the same character as that in *Ratufa affinis*, though less conspicuous.

As Mr. Thomas has pointed out to me, after examining a specimen of the latter, *Ratufa bunguranensis* is closely allied to *R. pyrsonota*. Indeed its relationship to the Siamese species is much closer than to the *R. ephippium* of Borneo. Together with *R. pyrsonota* the Bunguran giant squirrel differs conspicuously from that of Borneo in its narrow skull, lengthened audital bullæ, dark feet, dark median line on under surface of tail, and entirely brown back. From *R. pyrsonota*, however, it is readily separable by its darker, less ochraceous color both above and below, drab washed back, and by the much less distinct annulation of the hairs of the dorsal surface.

RATUFA NANOGIGAS (Thomas and Hartert).

1895. *Sciurus bicolor nanogigas* THOMAS and HARTERT, Novitates Zoologicæ, II, p. 491. December, 1895 (Pulo Laut).

1900. *Ratufa ephippium nanogigas* BONHOTE, Ann. and Mag. Nat. Hist., 7th ser., V, p. 498. June, 1900 (Pulo Laut).

Four specimens, all from Pulo Laut, the type locality.

This strongly characterized dwarf species is allied to *Ratufa pyrsonota* and *R. bunguranensis* with which it agrees in color scheme. It is in no way closely related to the large Bornean *R. ephippium*.

RATUFA ANGUSTICEPS sp. nov.

Type.—Adult male (skin and skull) No. 104646 U. S. National Museum. Collected on Pulo Lingung, off south coast of Bunguran, June 17, 1900. Original number 481.

Characters.—Externally like *Ratufa anambæ* and *R. melanocephala*. Skull about equal to that of latter in length, but conspicuously narrower.

Color.—As the color is precisely like that of *Ratufa anambæ* and *R. melanocephala* it requires no description.

Skull and teeth.—The skull is immediately recognizable by its general narrowness, but particularly in the region of the anterior zygomatic roots. Ratio of lachrymal breadth to greatest length, 39. In the other black backed species it is about 42. Audital bullæ narrower and more elongate than in *R. melanocephala*, and more elevated above level of basi-occipital (when skull is held upside down). Lateral processes of basi-occipital obsolete.

Teeth as in the related species.

Measurements.—External measurements of type: total length 748; head and body 342; tail vertebrae 406; hind foot 79 (74).

Cranial measurements of type: greatest length 48.6 (70);¹ basal length 57 (59); basilar length 52 (53); diastema 15.6 (16); length of nasals 22 (23.4); breadth of nasals anteriorly 12 (13); breadth of nasals posteriorly 6 (7); interorbital breadth 27 (28); lachrymal breadth 28.4 (31); breadth between tips of postorbital processes 38 (41); zygomatic breadth 41 (44); mastoid breadth 31 (32.6); mandible 40 (41.6); maxillary toothrow (alveoli) 14 (14); mandibular toothrow (alveoli) 14.6 (14.4).

Specimens examined.—One, the type.

Remarks.—While this squirrel exactly resembles the other black backed species with untufted ears, so far as external characters are concerned, it seems to be well differentiated in cranial peculiarities. No black backed *Ratufa* has hitherto been recorded from the Natunas.

RHINOSCIURUS sp.

An immature long-nosed squirrel was taken on Sirhassen Island, June 4, 1900. In the absence of material for comparison I am unable to determine the species. The genus is new to the islands.

ARCTOGALIDIA INORNATA sp. nov.

Type.—Adult² male (skin and skull) No. 104859 U. S. National Museum. Collected on Bunguran Island, North Natunas, June 23, 1900. Original number 502.

Characters.—Much smaller than *Arctogalidia leucotis* from the Malay Peninsula or *A. stigmatica* from Borneo (greatest length of skull about 100 instead of 115) and in color paler than either, the dark dorsal stripes obsolete in adult.

Color.—General color of back and sides light silvery gray irregularly suffused with buff and slightly darkened by blackish hair-tips and by appearance at surface of hair-brown basal portion of fur. The buff suffusion is least noticeable on back, slightly more apparent on sides and flanks, and most evident on sides of neck, where it usually brightens almost to buff-yellow in distinct contrast with surrounding parts. On middle of back there is a trace of the middle dark stripe of the three normally present in members of the genus. Head essentially like back though somewhat more gray. Muzzle and ill-defined

¹ Measurements in parentheses are those of the type of *Ratufa melanopepla*.

² Teeth very much worn and many of them absent.

eye ring blackish. Cheeks and short median stripe on forehead dull whitish gray. Under parts essentially like back, but buff tinge more diffuse. Feet and ears dark brown. Tail like back but darkening to uniform brown beyond middle.

Newly born young are clear bluish gray, with scarcely a tinge of buff. The three black dorsal stripes are clearly defined and normal in extent.

Skull.—In addition to its smaller size the skull differs from that of the Bornean *Arctogalidia stigmatica* in the relatively larger braincase, and less prominent audital bullæ. The braincase is nearly as broad as in the Bornean species, but the zygomatic width is distinctly less. Audital bullæ less raised above level of basi-occipital when skull is held upside down and viewed from behind. The sagittal crest, though of normal development in very old individuals, is absent at an age when it is well grown in the larger species. In *Arctogalidia leucotis* and *A. stigmatica*, even in animals so young that the teeth are unworn and all the sutures of the rostrum plainly visible, the sagittal crest is a knife-like ridge extending from proencephalon to lambdoid suture, and rising to a height of about 4 mm. over middle of braincase. In much older individuals of *A. inornata*, with worn teeth and nearly obliterated rostral sutures, the crest is represented by a low ridge about 5 mm. wide over middle of braincase and flat or grooved on top. At this stage it rises very inconspicuously above level of the adjacent surface, from which it is distinguished more by the texture of the bone than by actual form.

Teeth.—The teeth are uniformly much smaller than in *Arctogalidia leucotis* and *A. stigmatica*, but I can detect no important differences in form.

Measurements.—External measurements of type: total length 1027; head and body 469; tail vertebræ 558; hind foot 78 (73.) External measurements of an adult female: total length 911; head and body 431; tail vertebræ 480; hind foot 77 (72).

Cranial measurements of type: greatest length 102 (115);¹ basal length 96 (106); basilar length 92 (103); median palatal length 53 (60); palatal breadth between anterior molars 13 (15.4); zygomatic breadth 55 (60); breadth between tips of postorbital processes 41 (39); constriction in front of postorbital processes 19 (18); constriction behind postorbital processes 13 (12); breadth of braincase above roots of zygomata 32 (33); mastoid breadth 36 (38); mandible 76

¹ Measurements in parentheses are those of a young adult *A. stigmatica* from British North Borneo.

(86); maxillary toothrow (exclusive of incisors) 34^1 (41); mandibular toothrow (exclusive of incisors) 39 (44); crown of first upper molar 5.4×5 (5.4×5.6); crown of second upper molar 4×5 (5.4×6.4); crown of second lower molar 7×4.2 (8.4×5.4).

Specimens examined.—Seven (two young in alcohol and one skull without skin), all from the type locality.

Remarks.—*Arctogalidia inornata* is so distinct from the previously described species as to require no special comparisons. It is common on Bunguran where it frequents the cocoanut trees, living for the most part in the tops among the leaf stalks.

VIVERRA TANGALUNGA Gray.

1895. *Viverra tangalunga* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 490. December, 1895 (Bunguran).

Nine specimens from Bunguran. These agree in all respects with the Bornean animal.

TUPAIA SPLENDIDULA Gray.

1894. *Tupaia splendidula* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 656. September, 1894 (Bunguran).

1893. *Tupaia splendidula typica* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 489. December, 1895 (Bunguran).

Two specimens from Bunguran.

TUPAIA LUCIDA (Thomas and Hartert).

1895. *Tupaia splendidula lucida* THOMAS and HARTERT, *Novitates Zoologicae*, II, p. 490. December, 1895 (Pulo Laut).

Seven specimens (two in alcohol) from Pulo Laut.

TUPAIA SIRHASSENENSIS sp. nov.

1894. *Tupaia tana* THOMAS and HARTERT, *Novitates Zoologicae*, I, p. 657. September, 1894 (Sirhassen).

Type.—Adult male (skin and skull) No. 104712 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 5, 1900. Original number 442.

Characters.—In general similar to Bornean specimens of *Tupaia tana*, but smaller (hind foot 47 instead of 52, greatest length of skull 55 instead of 60), gray markings on head and shoulders less distinct, and red of tail brighter. Rostral portion of skull less attenuate than in *Tupaia tana*.

Color.—The color so exactly resembles that of the common Bornean *Tupaia tana* as to need no detailed description. Gray of head darker

¹Tooth measurements are from a younger specimen (male) with perfect dentition.

than in the Bornean animal and light shoulder markings less distinct and sharply defined. Under side of tail light orange-rufous, darkening to ferruginous toward edge. (In *T. tana* these colors are replaced by dull ferruginous and hazel respectively.)

Skull and teeth.—The skull is throughout much smaller than in specimens of *Tupaia tana* from Borneo. In form it differs from that of *T. tana* in less slender and elongate rostrum, narrower brain-case and slightly shorter audital bullæ. Suborbital vacuity much broader than in *T. tana*. Teeth as in the Bornean animal.

Measurements.—External measurements of type: Total length 355; head and body 203; tail vertebræ 152; hind foot 46.4 (44). Average and extremes of four adults from the type locality: total length 367 (365–371); head and body 203; tail vertebræ 163 (162–168); hind foot 45.4 (44–46.6); hind foot without claws 42.5 (41–44).

Cranial measurements of type: greatest length 54.6 (61);¹ basal length 49 (54); basilar length 46.4 (51); median palatal length 48 (53); distance from lachrymal notch to tip of premaxillary 27.6 (31); least interorbital breadth 14.4 (16); zygomatic breadth 25 (28.4); mandible 38 (41); maxillary toothrow (behind diastema) 20 (21.4); mandibular toothrow (behind diastema) 17 (18).

Specimens examined.—Five, all from the type locality.

GALEOPITHECUS VOLANS (Linnæus).

1894. *Galeopithecus volans* THOMAS and HARTERT, Novitates Zoologicae, 1, p. 657. September, 1894 (Bunguran and Sirhassen).

Two specimens from Sirhassen and two (one young in alcohol), from Bunguran. Also fœtus of one of the Sirhassen specimens.

EMBALLONURA ANAMBENSIS Miller.

Four specimens from Bunguran. These agree essentially with the Anamba animal, but show some slight cranial peculiarities.

PIPISTRELLUS SUBULIDENS sp. nov.

Type.—Adult female (in alcohol) No. 104758 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June 3, 1900.

Characters.—Similar to *Pipistrellus pipistrellus* (Schreber) in size, color and external form, but skull with broader rostrum, and inner upper incisor without supplemental cusp.

¹Measurements in parentheses are those of an adult male Bornean *Tupaia tana*.

Skull.—The skull is of the same size as that of *Pipistrellus pipistrellus*, but the braincase is narrower and more elongate, and the rostrum is very markedly shorter and broader. The great breadth of the anterior portion of the skull involves also the palate and interpterygoid space, both of which are noticeably wider than in *Pipistrellus pipistrellus*. Audital bullæ slightly smaller than in the European species.

Teeth.—The teeth are essentially as in *Pipistrellus pipistrellus*, except that the inner upper incisor lacks the small supplemental cusp. Mandibular teeth wider than those of *P. pipistrellus*.

Measurements.—External measurements of type: total length 76; head and body 41; tail 33; tibia 14; foot 6; calcar 10; forearm 32.4; thumb 6; second digit 30; third digit 60; fourth digit 53; fifth digit 43; ear from meatus 11; ear from crown 9; width of ear 9.6; tragus (measured in front) 4.

Cranial measurements of type: greatest length 12.4 (12);¹ basal length 11.8 (11.6); basilar length 9 (9); zygomatic breadth 8.4 (8); least interorbital breadth 3.2 (3.2); greatest length of braincase 8 (7.6); greatest breadth of braincase above roots of zygomata 6.6 (6.6); mandible 8.8 (8.4); maxillary toothrow (exclusive of incisors) 4.2 (4.2); mandibular toothrow (exclusive of incisors) 4.8 (4.8).

Specimens examined.—Six (in alcohol), all from the type locality.

Remarks.—I am unable to identify this bat with any described species. Externally it is practically identical with *Pipistrellus pipistrellus* except that the color, so far as can be judged from specimens preserved in alcohol, is more blackish. Internally it is readily distinguished by the characters of the skull and teeth. From *Pipistrellus abramus* it differs externally in smaller size, narrower ears, and in the absence of any unusual development of the penis. The incisors differ from those of *P. abramus* in the same manner as from those of *P. pipistrellus*.

HIPPOSIDEROS LARVATUS (Horsfield).

Two specimens (one in alcohol) were collected on Sirhassen Island, June 6 and 7, 1900.

RHINOLOPHUS AFFINIS (Horsfield).

One badly damaged specimen from Bunguran appears to be referable to typical *Rhinolophus affinis*. The forearm cannot be measured, but the third finger is 75 mm. in length. Tibia 21, foot 10.4,

¹Measurements in parentheses are those of an adult skull of *Pipistrellus pipistrellus* from Switzerland.

ear from meatus 21. Ridge on muzzle beneath edge of nose leaf low, broad and hairy, not in the least suggesting a supplementary leaflet.

RHINOLOPHUS SPADIX sp. nov.

1894. *Rhinolophus affinis* THOMAS and HARTERT, Novitates Zoologicae, II, p. 656. December, 1895 (Sirhassen).

Type.—Adult female (in alcohol) No. 104752 U. S. National Museum. Collected on Sirhassen Island, South Natunas, June, 1900.

Characters.—In general like *Rhinolophus affinis* but much smaller. Color uniform tawny brown. Muzzle with distinct supplemental leaflets.

Muzzle.—Muzzle and noseleaf precisely as in *Rhinolophus affinis*, except that the ridge on muzzle beneath edge of horseshoe is developed into a distinct supplemental leaflet resembling those present in *Hipposideros*. In this respect *Rhinolophus spadix* resembles the animal from Burmah referred by Thomas to *Rhinolophus rouxii*;¹ but the terminal erect portion of the noseleaf is not shortened or in any way peculiar in form.

Ears.—The ears resemble those of *Rhinolophus affinis*, except that they are not as large.

Color.—Fur everywhere russet, slightly paler on ventral surface, darker and somewhat tinged with hazel above. Ears and membranes dark brown.

Skull and teeth.—The skull and teeth exactly resemble those of mainland specimens of *Rhinolophus affinis* except for their uniformly smaller size.

Measurements.—External measurements of type: total length, 70 (85²); tail 21 (23); tibia 17.6 (24); foot 8 (10); calcar 12 (13); forearm 43 (51); thumb 8 (8.6); second digit 32 (40); third digit 64 (77); fourth digit 53 (61); fifth digit 54 (63); ear from meatus 17 (20); ear from crown 14 (17); length of noseleaf from lip 13 (16); greatest width of noseleaf 8 (9).

Cranial measurements of type: greatest length 18 (23); basal length 16 (20.4); basilar length 14.6 (18); zygomatic breadth 9 (11); least interorbital breadth 2.4 (2.4); greatest length of braincase 10.4 (13); greatest breadth of braincase above roots of zygomata 8 (9.4); frontopalatal depth (at middle of molar series) 4 (4.8); depth of braincase 6 (7); mandible 11.8 (15); maxillary tooththrow (exclusive

¹ Ann. Mus. Civ. di Storia Nat. di Genova, Ser. 2, x, p. 923, pl. xi, 1892.

² Measurements in parentheses are those of an adult female *Rhinolophus affinis* from Trong, Lower Siam.

of incisor) 6.8 (9); mandibular toothrow (exclusive of incisors) 7 (9.8).

Specimens examined.—Three (one skin), all from the type locality.

Remarks.—*Rhinolophus spadix* is so readily distinguished from its relatives of the *R. affinis* group that it needs no special comparisons. It is a much smaller animal than the species from the Anambas that I recently referred to *R. rouxii*.¹ In color the latter is a dull brown not in the least resembling the russet of *R. spadix*.

CYNOPTERUS MONTANOI Robin.

1894. *Cynopterus marginatus* THOMAS and HARTERT, *Novitates Zoologicæ*, 1, p. 655. September, 1894 (Sirhassen and Bunguran).

1899. *Cynopterus montanoi* MATSCHIE, *Die Fledermäuse des Berliner Museums für Naturkunde*, p. 75. August, 1899. (Natuna record of *C. marginatus* placed in synonymy of *C. montanoi*.)

Five specimens (three skins) from Sirhassen. These agree so closely with a skin and two bleached alcoholic specimens from Singapore, which I suppose to be the same as the Malaccan *Cynopterus montanoi*, that without more material it is impossible to distinguish the Natuna animal from that of the southern extremity of the Malay Peninsula. *Cynopterus montanoi* as thus understood differs from *C. angulatus* Miller² of Lower Siam in its more slender skull and in the absence of the white border of the ear, and from *C. titthæcheilus* (Temminck) of Sumatra and Java in its conspicuously smaller size.

PTEROPUS VAMPIRUS (Linnæus).

1894. *Pteropus vampyrus* THOMAS and HARTERT, *Novitates Zoologicæ*, 1, p. 655. September, 1894 (Bunguran).

1895. *Pteropus vampyrus* THOMAS and HARTERT, *Novitates Zoologicæ*, 11, p. 489. December, 1895 (Bunguran).

Six skins from Bunguran.

? PTEROPUS HYPOMELANUS Temminck.

1894. *Pteropus hypomelanus* THOMAS and HARTERT, *Novitates Zoologicæ*, 1, p. 655. September, 1894 (Sirhassen).

1895. *Pteropus hypomelanus* THOMAS and HARTERT, *Novitates Zoologicæ*, 11, p. 489. December, 1895 (Pulo Pandak, Pulo Panjang and Pulo Laut).

Eight (one in alcohol) from Sirhassen and seven (one in alcohol) Pulo Laut. It is highly probable that these specimens represent a species distinct from the true *Pteropus hypomelanus* of Ternate.

¹ Proc. Washington Acad. Sci., 11, p. 234. August 20, 1900.

² Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 316. July, 1898.

NYCTICEBUS TARDIGRADUS (Linnæus).

1894. *Nycticebus tardigradus* THOMAS and HARTERT, Novitates Zoologicæ, I, p. 655. September, 1894 (Bunguran).
1895. *Nycticebus tardigradus* THOMAS and HARTERT, Novitates Zoologicæ, II, p. 489 (Bunguran).

One specimen from Bunguran.

MACACUS 'CYNOMOLGUS' Auct.

1894. *Macacus cynomolgus* THOMAS and HARTERT, Novitates Zoologicæ, I, p. 654. September, 1894 (Bunguran).
1895. *Macacus cynomolgus* THOMAS and HARTERT, Novitates Zoologicæ, II, p. 489. December, 1895 (Bunguran).

A specimen from each of the following islands: Sirhassen, Pulo Lingung and Pulo Laut.

SEMNOPITHECUS CRISTATUS (Raffles).

Two monkeys from Sirhassen appear to be referable to this species.

SEMNOPITHECUS NATUNÆ Thomas and Hartert.

1894. *Semnopithecus natunæ* THOMAS and HARTERT, Novitates Zoologicæ, I, p. 652. September, 1894 (Bunguran).
1895. *Semnopithecus natunæ* THOMAS and HARTERT, Novitates Zoologicæ, II, p. 489. (Bunguran.)

Ten specimens from Bunguran.

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RESULTS OF THE BRANNER-AGASSIZ
EXPEDITION TO BRAZIL.

V.

MOLLUSKS FROM THE VICINITY OF
PERNAMBUCO.

BY WILLIAM HEALEY DALL.

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DURING Dr. J. C. Branner's expedition for the study of the coast reefs of Northeastern Brazil collections of various invertebrates were made. As this region is seldom visited by naturalists and is important in the study of the geographical distribution of the mollusks of the Western Atlantic, Dr. Branner requested me to report on that part of the collection.

Both Dr. Pilsbry and myself in listing collections of shells from the Brazilian and Uruguayan coasts have been struck with the predominant Antillean element among the mollusks, and it seems as if the present distribution of littoral species must have been largely brought about before the discharge of the Amazonian watershed attained its present volume, since it is difficult to imagine exclusively shore species passing the barrier of several hundred miles of fresh water which intervenes between the present northern and southern strips of coast unaffected by this mighty flood. The present collection confirms the view previously taken of the very large Antillean element in the fauna. Ninety-one species in all were obtained; deduct-

ing from them four confined to land or fresh water, there remain eighty-seven, of which thirteen alone are peculiar to the eastern coast of South America south of the West Indies, and seventy-four are common Antillean shells. Two appeared to be undescribed, and one, a very young *Octopus*, was too immature for identification. This would leave eight-ninths of the species in common with the fauna of the Antilles. A large proportion of these extend at least as far southward as Montevideo, and the southern limit of the Antillean fauna may be regarded as situated in that vicinity.

Most of Dr. Branner's shells were obtained from the vicinity of Pernambuco, collections were made from the existing coral reefs, the limestone reefs of doubtful age which exist along this coast, and to some extent from the sand beaches behind the reefs. The collection was not large enough to indicate whether the fauna of the stone reefs and that of the coral reefs differ, but in all probability they do not.

The localities from which mollusks were obtained are as follows:

Pernambuco and Tacuara near by.

Maceio; on granite boulders, sand beach and reefs, latitude 9° 40' S.

Boa Viagem; stone reef.

Cotonello Bay.

Managuas and Mangosoules on the Rio Parahyba do Norte, Cabedello; mangrove swamps.

Mamanguape; stone reef, latitude 6° 58' S.

Rio Goyanna; stone reef off the mouth of the river, latitude 6° 33' S.

Among the local species *Voluta hebræa* and *Turbinella ovoidea* appeared to be common, and *Fasciolaria aurantiaca* abundant. No peculiarity of texture or aspect which could be regarded as general differentiates the Antillean species of Brazil from the individuals of the same species found in the West Indies, the only approximation to such a feature being the gray color of the specimens of *Trivia pediculus* which I have not observed in any of our very numerous series of that species from the West Indies and Florida.

LIST OF THE SPECIES OBTAINED.

Ostrea puelchana d'Orbigny.

Mangosoules, Managuas and Maceio.

Ostrea equestris Say.

Managuas; attached to the shells of *Cerithium algicola*.

Spondylus echinatus Martyn.

Mamanguape; a single young valve.

Lima inflata Lamarck.

Maceio.

Margaritifera radiata Leach.

Goyanna; a single young valve.

Mytilus exustus Linné.

Maceio; young shell from oysters.

Mytilus exiguus Dunker.

Mamanguape; young shells.

Modiolus (Gregariella) coralliophagus Gmelin.

A single specimen at Cotonello Bay and another from a rock reef at Goyanna. This form is remarkable for the series of four or five sharp conical teeth on the hinge on each side of the largely internal ligament. These teeth are below the line of the marginal serrations. The exterior of the shell is covered with a concretinary layer which completely hides the posterior part of the valves and must act as a sort of operculum closing the entrance of its burrow against enemies and protecting the mollusk. This layer, like that on *Diberus*, must be partly due to the animal itself.

Lithophaga (Diberus) antillarum d'Orbigny.

Mamanguape, Maceio, Goyanna and Pernambuco; in coral.

Lithophaga nigra d'Orbigny.

Boa Viagem; one specimen.

Arca umbonata Lamarck.

Common on the reefs at Goyanna, Mamanguape, Pernambuco, Maceio and Boa Viagem.

Arca Adamsi (Shuttleworth) Smith.

Maceio, Mamanguape and Goyanna.

Arca (Scapharca) Deshayesii Hanley.

Pernambuco; one valve.

Arca (Cunearca) brasiliiana Lamarck.

Mamanguape; one valve.

Phacoides pectinatus Gmelin.

Mangosoules.

- Codakia orbicularis** Linné.
Maceio.
- Divaricella quadrisulcata** d'Orbigny.
Tacuara, Pernambuco.
- Cardium muricatum** Linné.
Pernambuco.
- Venus (Chione) cancellata** Linné.
Goyanna.
- Venus (Anomalocardia) flexuosa** Linné.
Mangosoules.
- Tivela mactroides** Born.
Mamanguape.
- Petricola typica** Jonas.
Maceio, Pernambuco and Boa Viagem; in coral.
- Sanguinolaria sanguinolenta** Gmelin.
Mamanguape.
- Tellina lineata** Turton.
Mangosoules and Maceio.
- Semele proficua** Pulteney.
Managuas.
- Mactrella alata** Spengler.
Mamanguape.
- Mulinia Branneri** Dall, n. sp.
Mamanguape.
- Gastrochæna ovata** Sowerby.
Goyanna; burrowing in stone.
- Martesia clavata** Lamarck.
Goyanna.
- Disciniscia antillarum** d'Orbigny.
Goyanna; on the reef.
- Strophocheilus pudicus** Müller.
Mamanguape.
- Oxystyla pulchella** Spix.
Pernambuco.
- Planorbis helopilus** d'Orbigny.
Pernambuco.
- Bulla striata** Bruguière.
Mangosoules, Managuas and Maceio.
- Micromelo undata** Bruguière.
Goyanna; on the reef.
- Terebra cinerea** Born.
Goyanna, Maceio, and Boa Viagem.

Drillia Greeleyi Dall, n. sp.

Goyanna; on the reef.

Voluta hebræa Linné.

Pernambuco and Maceio; common.

Turbinella ovoidea Kiener.

Pernambuco, Managuas and Maceio.

Fasciolaria aurantiaca Lamarck.

Maceio, Pernambuco and Managuas.

Melongena morio Linné.

Mangosoules, Managuas and Maceio.

Latirus (Leucozonia) cingulifera Lamarck.

Pernambuco, Maceio and Goyanna; common.

Latirus (Leucozonia) ocellata Lamarck.

Pernambuco, Maceio and Goyanna; common.

Tritonidea auritula Link.

Pernambuco, Maceio, Mamanguape and Goyanna.

Pisania janeirensis d'Orbigny.

Maceio; on the reef.

Nassa vibex Say.

Rio Parahyba and Boa Viagem.

Anachis lyrata Sowerby.

Pernambuco, Boa Viagem and Cotonello Bay.

Columbella mercatoria Lamarck.

Maceio, and on the reef at Boa Viagem.

Murex brevifrons Lamarck.

Mangosoules and Managuas; young shells.

Purpura deltoidea Lamarck.

Pernambuco and Maceio.

Purpura (var.?) trinitatensis Guppy.

Mamanguape, Mangosoules, Managuas, Maceio, Goyanna and Pernambuco; common.

Coralliophila galea Gmelin.

Maceio; very variable.

Janthina communis Lamarck.

Mamanguape.

Distortrix reticulata Link.

Mangosoules.

Gyrineum ponderosum Reeve.

Maceio. This may prove but one of the varieties of *Ranella affinis* Broderip, but the subdivisions by sculpture are convenient.

Lampusia pilearis Lamarck.

Goyanna.

Lampusia chlorostoma Lamarck.

Maceio ; young, on the reef.

Cassis tuberosa Linné.

Maceio.

Cassis flammea Linné.

Maceio.

Cassis inflata Shaw.

Mamanguape.

Dolium perdix Lamarck.

Maceio.

Dolium olearium Lamarck.

Maceio.

Cypræa exanthema Linné.

Maceio and Mamanguape.

Cypræa spurca Linné.

Mamanguape.

Trivia pediculus Linné.

Maceio and Boa Viagem. A dark gray form with the usual dark spots, but no suggestion of pink coloration.

Cerithium algicola C. B. Adams.

Mangosoules, Managuas, Mamanguape, and Maceio ; common.

Cerithium thomasia Sowerby.

Maceio and Goyanna. Probably a variety of *algicola* with depauperate sculpture.

Melaraphe nebulosa Lamarck.

Rio Parahyba, Mangosoules and Managuas, on shrubs near the water ; Maceio, on granite boulders on the shore.

Melaraphe columellaris d'Orbigny.

Maceio ; on granite boulders.

Melaraphe columellaris var. *flava* Broderip.

Rio Parahyba.

Ampullaria zonata Spix.

Managuas, and Traicao on the Mamanguape River.

Amalthea antiquata Linné.

Maceio.

Amalthea subrufa Carpenter.

Boa Viagem.

Polynices mamillaris Linné.

Mamanguape and Maceio.

Polynices porcellana d'Orbigny.

Maceio.

Natica canrena Lamarck.

Managuas.

Natica livida Pfeiffer.

Rio Parahyba, Mangosoules and Maceio; on sand beaches.

Natica marochiensis Gmelin.

Mamanguape, Mangosoules and Managuas.

Acmæa onychina Gould.

Mamanguape and Goyanna.

Turbo Spenglerianus Gmelin.

Managuas.

Astralium latispina Philippi.

Mangosoules, Rio Parahyba and Managuas.

Astralium imbricatum Gmelin.

Mamanguape and Maceio; common.

Astralium armatum Philippi.

Goyanna.

Omphalius viridulus Gmelin.

Mamanguape, Maceio, Goyanna and Pernambuco; common.

Neritina virginea Lamarck.

Rio Parahyba, Managuas, Mangosoules, and Goyanna. The shells are usually smaller than those found in the Antilles but pass through the same multitude of color variations.

Submarginula octoradiata Gmelin.

Maceio.

Fissurella rosea Gmelin.

Mamanguape, Maceio and Goyanna.

Fissuridea alternata Say.

Maceio and Goyanna.

Fissuridea Listeri d'Orbigny.

Maceio; one young shell.

Ischnochiton squamulosus C. B. Adams.

Maceio; one young specimen.

Octopus sp. indet.

One very young specimen from the reefs.

DESCRIPTION OF THE NEW SPECIES.

Mulinia Branneri Dall.

Shell small, solid, elevated, short, subtriangular, white under a pale brownish periostracum; beaks high, full, subcarinate behind; an obscure impressed line in front proceeding from the beaks delimits a

Proc. Wash. Acad. Sci., April, 1901.

lanceolate area simulating a lunule; a similar line on the opposite slope within the carina marks a smaller area which may be compared to an escutcheon; the space between this line and the carina which extends from the beaks to the lower posterior angle of the valves, has the periostracum exceptionally rugose; and on the carina itself this feature is elevated into a low keel which disappears in drying; the periostracum is concentrically wrinkled and even lamellose toward the margin, with irregular small radial wrinkling; the valves are polished beneath the periostracum, practically smooth, and nearly equilateral, rounded in front, arcuate below and bluntly pointed behind; the hinge is normal and strong, the pallial impression broad and indented by a narrow linguiform sinus reaching nearly to the vertical of the beaks. Lon. of shell 22.5, alt. 18.5, diam. 13.5 mm.

This neat little species is perhaps the same as the "*Mulinia* near *lateralis* Say" mentioned in Pilsbry's list of the shells obtained by Dr. Rush at Maldonado Bay, Uruguay (*Nautilus*, xi, p. 8, May, 1897). It is larger and less rostrate than any specimens of *M. lateralis* I have seen. The nearest relative I have noticed in the American series of this group is *Mulinia portoricensis* Shuttleworth, which is pretty close to the present species, though more produced at the ends and much more rostrate than *M. Branneri*. The latter is named in honor of Dr. J. C. Branner of Stanford University to whom the formation of the collection is due.

Drillia Greeleyi Dall.

Shell small, stout, solid, acute with eight or nine whorls; nucleus small, smooth, dark reddish purple with two whorls followed by a third with strong arcuate ribs concave anteriorly, and which at the end of the whorl are replaced by transverse nodules separated from the suture behind by a revolving ridge; the last whorl has twelve or thirteen narrow transverse ribs, extending forward from the anal fasciole; behind the fasciole a stout ridge revolves a little in advance of the appressed edge of the whorl, the ridge is nodulous where it rides over the ribs of the preceding whorl; in front of the fasciole the ribs are crossed by two adjacent and four rather distant stout revolving threads, beside which there are four or five smaller threads on the canal, and in the interstices and on the fasciole extremely fine sharp revolving threads; all the large threads form nodules where they cross the ribs and these nodules are yellow, the shell elsewhere being dark reddish, nearly black; the last whorl is more than half the shell; the aperture narrow and dark. Lon. 10.5, max. diam. 4.5 mm.

This neat shell is not quite mature and its aperture in the adult state cannot be described, but is undoubtedly normal. The species belongs in the section *Crassispira* near such species as *D. albinodata* Reeve, but differs in details of sculpture as described from all those with which I have compared it. It is named in honor of Mr. A. W. Greeley who, under the direction of Dr. Branner, collected it and nearly all the specimens mentioned in this paper.

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NEW BIRDS OF THE FAMILIES TANAGRIDÆ
AND ICTERIDÆ.

BY

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THIS is one of a series of papers comprising advance descriptions of new birds, prepared by the author in connection with his forthcoming work on the *Birds of North and Middle America*. Six papers of this series describing new forms in the families Fringillidæ and Corvidæ, have appeared in the *Auk*, Vols. XV (1898) to XVII (1900).

TANAGRIDÆ.

Calospiza florida arcæi. ARCE'S CALLISTE.

Similar to *Calospiza florida florida* but smaller, the general color more yellowish green; adult male without a distinct, if any, occipital patch of yellow.

Veragua.

Type, no. 146386, U. S. National Museum, ♂ adult, Veragua; E. Arce.

Piranga roseo-gularis cozumelæ. COZUMEL TANAGER.

Similar to *Piranga roseo-gularis roseo-gularis* but red of pileum duller, wing averaging shorter and tail longer.

Island of Cozumel, Yucatan.

Type, no. 102689, U. S. National Museum, ♂ ad., Cozumel I., Yucatan, Jan. 29, 1885; J. E. Benedict and T. Lee.

Ramphocelus dimidiatus isthmicus. McLEANNAN'S TANAGER.

Similar to *Ramphocelus dimidiatus dimidiatus*, but colors duller, the abdomen brownish black or dark brown instead of deep black and tail longer.

Isthmus of Panama.

Type, no. 16883, U. S. National Museum, ♂ ad., Frijole Station, Panama R. R.; J. McLeannan.

Phenicothraupis salvini peninsularis. YUCATAN TANAGER.

Similar to *Phenicothraupis salvini insularis*, but darker and less grayish, though much paler and grayer than *P. salvini salvini*.

Yucatan (mainland).

Type, no. 146607, U. S. National Museum, ♂ ad., Izalam, Yucatan, 1880; Geo. F. Gaumer.

Phenicothraupis salvini discolor. ESCONDIDO TANAGER.

Similar to *Phenicothraupis salvini salvini*, but adult male much darker and less brightly colored, the back, etc., dull reddish brown, the under parts of body strongly tinged with grayish. (Nearly intermediate in coloration between *P. salvini salvini* and *P. fuscicauda*, but female and young not at all like those of the latter.)

Southern Honduras to eastern Nicaragua.

Type, no. 126942, U. S. National Museum, ♂ ad., Rio Escondido, eastern Nicaragua, May 12, 1892; Chas. W. Richmond.

Chlorospingus sumichrasti. SUMICHRAST'S CHLOROSPINGUS.

Similar to *C. ophthalmicus*, but pileum lighter and clearer brown, back more brownish olive-green, and chest paler and duller yellowish olive.

Mountains of Vera Cruz, southeastern Mexico.

Type, no. 37511, U. S. National Museum, Mt. Azul, near Orizaba, Vera Cruz, October, 1864, Professor F. Sumichrast.

Genus *Iridophanes*. (*Type*, *Dacnis pulcherrima* Scater.)

Similar to *Tanagrella*, Swainson, but nasal fossæ mostly unfeathered, bill more slender (though relatively broader basally), and four outermost primaries (sixth to ninth) more nearly equal in length.

Although this form has usually been considered a member of a Cœrebine genus (*Dacnis*) I am inclined to believe that its relationships are in reality Tanagrine, as has already been suggested by DuBus, according to Dr. Scater.¹

¹ Cat. Birds Brit. Mus., Vol. XI, 1886. p. 25.

ICTERIDÆ.

Zarhynchus wagleri mexicanus. MEXICAN OROPENDOLA.

Similar to *Zarhynchus wagleri wagleri*, but slightly smaller, especially the bill, with frontal shield narrower and less arched; chestnut of head and neck slightly, that of rump and flanks decidedly, darker; black of breast and abdomen more restricted, duller, less glossy.

Southern Mexico to Guatemala; British Honduras? Honduras?

Type, no. 144561, U. S. National Museum (Biol. Surv. Coll. no. 1755), ♂ ad., Motzorongo, Vera Cruz, Mexico, Feb. 26, 1894; Nelson and Goldman.

Holoquiscalus martinicensis. MARTINIQUE GRACKLE.

Similar to *Holoquiscalus inflexirostris*, of Santa Lucia, but smaller, and with stouter bill; adult female with head and under parts paler, the chin and throat nearly white. (The adult female similar in coloration to that of *Holoquiscalus guadeloupensis*, but smaller and with more slender bill.)

Island of Martinique, Lesser Antilles.

Type, no. 75156, U. S. National Museum, ♂ ad., Martinique; F. A. Ober.

The forms belonging to this group, as I have been able to make them out, are as follows:

- (1) *Holoquiscalus gundlachii* (Cassin); Cuba.
- (2) *Holoquiscalus jamaicensis* (Daudin); Jamaica.
- (3) *Holoquiscalus niger* (Boddaert); Haiti.
- (4) *Holoquiscalus brachypterus* (Cassin); Puerto Rico.
- (5) *Holoquiscalus caymanensis* (Cory); Grand Cayman.
- (6) *Holoquiscalus luminosus* (Lawrence); Grenada.
- (7) *Holoquiscalus inflexirostris* (Swainson); Santa Lucia.
- (8) *Holoquiscalus guadeloupensis* (Lawrence); Guadeloupe.
- (9) *Holoquiscalus martinicensis* (Ridgway); Martinique.
- (10) *Holoquiscalus insularis* (Richmond); Margarita I., Venezuela.
- (11) *Holoquiscalus lugubris* (Swainson); Trinidad, Tobago, and adjacent mainland.
- (12) *Holoquiscalus rectirostris* (Cassin); (habitat unknown).
- (13) *Holoquiscalus fortirostris* (Lawrence); Barbados.

Scaphidurus major nelsoni. SONORAN BOAT-TAIL.¹

¹*Scaphidurus* SWAINSON, Philos. Mag., new series, i, 1827, p. 437. Type, *S. palustris* Swainson.

Similar to *Scaphidurus major graysoni* but slightly smaller, with slightly longer bill; adult female much paler, the under parts (in winter plumage) light wood brown, passing into brownish cream-buff on throat and chin, into grayish brown on flanks, thighs and anal region, the under tail-coverts dark grayish brown, pileum and hindneck light sepia-brown, the scapulars and interscapulars margined with the same.

Coast district of Sonora, northwestern Mexico.

Type, no. 164596, U. S. National Museum (Biol. Surv. Coll., no. 6140), ♀ ad., Alamos, Sonora, Jan. 27, 1899; E. A. Goldman.

The known forms belonging to this genus are, according to my recent revision of the group, as follows:

(1) *Scaphidurus major major* (Vieillot): South Atlantic and Gulf Coast United States.

(2) *Scaphidurus major macrourus* (Swainson): southern Texas to northern Columbia.

(3) *Scaphidurus major obscurus* (Nelson): southwestern Mexico.

(4) *Scaphidurus major graysoni* (Sclater): western Mexico.

(5) *Scaphidurus major nelsoni* Ridgway: northwestern Mexico.

(6) *Scaphidurus major assimilis* (Sclater): central Colombia.

(7) *Scaphidurus tenuirostris* (Swainson): central Mexico.

(8) *Scaphidurus nicaraguensis* (Salvin & Godman): Nicaragua.

***Icterus cucullatus sennetti*. SENNETT'S ORIOLE.**

Similar to *Icterus cucullatus cucullatus* (Swainson) but paler in color; adult male less decidedly orange, the color of pileum, chest, etc., deep cadmium yellow, never cadmium orange; adult female much paler than that of *I. c. cucullatus*, the yellow of under parts dull or pale gamboge, instead of saffron or ochreous, the back and scapulars lighter grayish.

Lower Rio Grande Valley, in Texas and Tamaulipas; south in winter to Morelos.

Type, no. 73654, U. S. National Museum, ♂ ad., Brownsville, Texas, April 3, 1877; Geo. B. Sennett.

***Icterus gularis tamaulipensis*. ALTA MIRA ORIOLE.**

Similar to *Icterus gularis gularis* (Wagler) but decidedly smaller and coloration more intense, the orange-yellow more decidedly orange (usually rich cadmium orange); black at anterior extremity of malar region broader; bill shorter and deeper at base. Similar to *Icterus gularis yucatanensis*, Berlepsch, but larger, usually less intense in color, and with the maxilla relatively much narrower.

Eastern Mexico, in states of Tamaulipas, Vera Cruz, San Luis Potosi, and Puebla.

Type, no. 135168, U. S. National Museum, ♂ ad., Alta Mira, Tamaulipas, E. Mexico, Oct. 17, 1894; F. B. Armstrong.

***Icterus mesomelas taczanowskii*. TACZANOWSKI'S ORIOLE.**

Similar to *Icterus mesomelas mesomelas* (Wagler), but slightly smaller and with black at base of inner webs of lateral rectrices more restricted, less intense, and less sharply defined.

Western Ecuador; Central Peru? Geographic range widely separated from that of *I. m. mesomelas* by the intervening much larger black-winged Central American form, *Icterus mesomelas salvinii* (Cassin).

Type, no. 101265, U. S. National Museum, adult (♂?), Guayaquil, Ecuador, 1884; Dr. Wm. H. Jones, U. S. N.

***Agelaius phœniceus fortis*. THICK-BILLED RED-WING.**

Similar to *Agelaius phœniceus phœniceus*, but decidedly larger, with bill relatively much shorter and thicker; adult females, adult male in winter, and immature males similar in coloration to the same of *A. p. sonoriensis*, but distinguished by very different measurements.

Breeding range unknown, but evidently somewhere in the central portion of North America; during migrations occurring in Manitoba, Minnesota, Nebraska, Indian Territory, Illinois (rarely or casually), and westward to and including the Rocky Mountains and southward to Arizona, northern Chihuahua, New Mexico, and western Texas.

Type, no. 88092, U. S. National Museum, ♀ ad., Omaha, Nebraska, March 9, 1878; Dr. R. W. Shufeldt.

***Agelaius phœniceus neutralis*. SAN DIEGO RED-WING.**

Similar to *A. p. sonoriensis* but smaller; adult female much darker, with streaks less strongly contrasted above, those on under parts rather broader and grayer, the upper parts with little if any of rusty, even in winter.

Great Basin district of United States northward to eastern British Columbia, southwestward to southern California (San Diego district) and northern Lower California.

Type, no. 134297, U. S. National Museum, ♀ ad., Jacumba, San Diego Co., California, May 26, 1894; Dr. Edgar A. Mearns, U. S. A.

***Agelaius phœniceus caurinus*. NORTHWESTERN RED-WING.**

Similar to *A. p. phœniceus* but wings and bill longer, the latter more slender; adult male with buff of middle wing-coverts deeper (deep

ochraceous-buff or ochraceous in winter); adult female more heavily streaked with black beneath, and, in winter plumage, with upper parts much more conspicuously marked with rusty.

Northwest coast district, from British Columbia (Vancouver Island and coast of mainland) south through western Washington and Oregon to northern California (Mendocino County, May 20).

Type, no. 153275, U. S. National Museum, ♀ ad., Cedar Hill, Vancouver Island, April 19, 1895; John Fannin.

The North American *Agelaii*, including those of Mexico and the West Indies, as they appear from my recent revision of the group, are as follows:

(1) *Agelaius tricolor* (Audubon); California and Oregon, west of Sierra Nevada and Cascade Mts.

(2) *Agelaius gubernator gubernator* (Wagler); southwestern part of Mexican plateau.

(3) *Agelaius gubernator californicus*, Nelson.; California (coast district) and western Oregon.

(4) *Agelaius gubernator grandis* (Nelson); southeastern part of Mexican plateau.

(5) *Agelaius phœniceus phœniceus* (Linnaeus); eastern North America, to base of Rocky Mts.

(6) *Agelaius phœniceus floridanus*, Maynard; Florida and Gulf coast to Galveston, Texas.

(7) *Agelaius phœniceus bryanti*, Ridgway; Bahamas and southeastern Florida.

(8) *Agelaius phœniceus richmondi*, Nelson; southern Texas south through eastern Mexico to Nicaragua.

(9) *Agelaius phœniceus sonoriensis*, Ridgway; southern Arizona and Colorado Valley in California, south to Tepic, western Mexico.

(10) *Agelaius phœniceus neutralis*, Ridgway; west slope of Rocky Mts., to California and northern Lower California.

(11) *Agelaius phœnicus caurinus*, Ridgway; northwest coast, in Washington and British Columbia; northern California in winter.

(12) *Agelaius phœnicus fortis*, Ridgway; Rocky Mts., Great Plains, etc., during migration; breeding range unknown.

(13) *Agelaius assimilis*, Gundlach; Cuba.

(14) *Agelaius humeralis* (Vigors); Cuba.

(15) *Agelaius xanthomus*, Sclater; Puerto Rico

Genus **Pseudagelæus**. (Type, *Agelæus imthurni* Sclater.)

Allied to *Scaphidurus*, but bill more slender, more attenuated and less strongly decurved terminally; tail less graduated, the graduation less than one fourth the length of middle rectrices (instead of between one fourth and one third as much); lateral toes longer, their claws reaching to base of middle claw.

Type, Agelæus imthurni, SCLATER. (Monotypic.)

Genus **Xanthopsar**. (Type, *Oriolus flavus* Gmelin.)

Similar to *Agelaius*, but bill relatively much longer and more slender, equaling or exceeding the head in length; ninth primary longest, or equal to the longest (the ninth, eighth and seventh about equal in length); tarsus relatively shorter (but little longer than culmen and but little more than one fourth as long as wing); middle toe, with claw, longer than tarsus; claw of inner toe falling short of base of middle claw, the outer toe still shorter; hallux decidedly shorter than lateral toes, its claw very long (exceeding the digit in length) and narrow, the anterior claws relatively very small.

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PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXI.

THE HYDROIDS.

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INTRODUCTION.

The collection of Hydroida secured by the Harriman Expedition is of exceptional interest, and proves to be one of the most important and most extensive collections of these beautiful forms of marine life thus far made in Alaskan waters. Our previous knowledge of the Hydroid fauna of this region rested almost exclusively on the collection made by Dr. W. H. Dall and his associates during the years 1871-1874 and reported on by Dr. S. F. Clark.¹ The number of species listed in Clark's report is 41, in which was included *Coppinia arcta*, now known to be merely the gonosome of *Lafœa*. Of these 40 species, 15 are well known British forms, and only one was then known from the Atlantic coast of the United States. The remaining 24 species were new.

¹Report on the Hydroids collected on the coast of Alaska and the Aleutian Islands by W. H. Dall, U. S. Coast Survey, and party, from 1871 to 1874, inclusive. Proc. Acad. Nat. Sciences, Philadelphia, 1876.

In 1878 C. Mereschkowsky¹ added a single species to the Alaskan fauna, bringing the total up to 41.

No other additions were made until 1899, when I added eight, of which three were well known British species and five were new.² That made a total of 49 species reported prior to the Harriman Expedition.

The collection here treated of comprises 53 species, 24 of which had been previously reported. Of the remainder, 9 were previously recorded from other localities, and 20 are new. Thus the Harriman Expedition has added about 60 percent to the number of species hitherto known from Alaskan waters. More than half of the species secured are new to Alaska and nearly 40 percent are new to science.

The whole number of species of hydroids now known from Alaska is 78. Considering the small amount of collecting that has been done in that region, compared with the extensive explorations of the coasts of Europe and the Atlantic coast of the United States, one may confidently expect that the waters of the far Northwest will prove to be very rich in hydroid life.

GEOGRAPHIC DISTRIBUTION.

A table is here given to indicate, first, the localities at which each species was collected by the Harriman Expedition, and second, the extent to which Hydroids have been distributed southward along meridional lines from what appears to have been a polar center of distribution. No attempt has been made to represent the complete distribution of the species.

A glance at the part of the table showing the distribution as represented in the collection secured by the expedition, shows an apparent poverty of the Hydroid fauna of the western, as compared with the eastern, portion of the territory explored. For convenience in such comparison the stations are arranged consecutively from east to west. The largest series were obtained at Berg Inlet in Glacier Bay; Yakutat Bay; and at Orca in Prince William Sound. These localities are all in deep bays, sheltered from storms and surrounded by rocky shores. On

¹ New Hydroida from Ochotsk, Kamtschatka, and other parts of the North Pacific Ocean. *Annals and Mag. Nat. Hist.*, Dec., 1878.

² Hydroida from Alaska and Puget Sound. *Proc. U. S. Nat. Museum*, Vol. XXI. (No. 1171.)

GEOGRAPHIC DISTRIBUTION OF THE HYDROIDS COLLECTED BY
THE HARRIMAN EXPEDITION.

Name. ¹	Distribution of Specimens in the Harri- man Collection.									General Distribution.				
	Juneau.	Sitka.	Berg Inlet.	Yakutat.	Orca.	Kadiak.	Popof Island.	Unalaska.	Dutch Harbor.	Europe.	Arctic Regions.	East Coast U. S.	Pacific Coast South of Alaska.	Alaska only.
Syncoryne eximia.	+	+	+
*Coryne brachiata.
*Garveia annulata.	+
Garveia nutans.
Eudendrium vaginatum.	+	+
*Tubularia harrimani.
*Campanularia ritteri.	+
Campanularia denticulata.
Campanularia verticillata.
Campanularia lineata.
Campanularia speciosa.
Campanularia urceolata.
*Campanularia reduplicata.
*Campanularia regia.
Clytia caliculata.
Clytia compressa.
Obelia plicata.
Obelia dichotoma.
*Obelia borealis.
*Obelia dubia.
Hebella pocillum.
*Gonothyræa inornata.
*Campanulina rugosa.
Calycella syringa.
Lafœa dumosa.
Lafœa gracillima.
Lafœa fruticosa.
*Lafœa adherens.
*Grammarea immersa.
Filellum serpens
Halecium halecinum.
Halecium muricatum.
Halecium scutum.
*Halecium reversum.
*Halecium robustum.
*Halecium ornatum.
*Halecium speciosum.
Sertularella tricuspidata.
Sertularella polyzonias.
*Sertularella saccata.
Thuiaria argentea.
Thuiaria similis.
Thuiaria variabilis.
Thuiaria cupressoides.
*Thuiaria coei.
Thuiaria fabricii.
Thuiaria turgida.
Thuiaria gigantea.
Thuiaria thuiarioides.
*Thuiaria elegans.
*Thuiaria costata.
Plumularia lagenifera.
Plumularia palmeri.
Totals.	10	4	12	15	13	8	3	1	4	19	18	14	20	25

¹ Species marked by a * are new.

account of the presence of perpetual ice in the form of glacier fronts and bergs, the water must be very cold the year around. Such a combination of conditions is particularly favorable to Hydroid life and accounts for the remarkably rich collections made at these places and also for the presence of so many arctic species. In this connection it is interesting to note the following paragraph written about twenty five years ago by Dr. Dall: "The material derived from the northwestern coasts of America, from Cook's Inlet south and east, indicates a series of Arctic colonies in favored localities, the future exploration of which offers a labor of the highest interest. These colonies are situated where the depth of water, the drippings of glaciers, and the high and adjacent shores of the Great Archipelago combine to reduce the temperature of the water below its apparently normal isotherm. Cook's Inlet affords one of them, one exists in the Gulf of Georgia, and others only await further exploration."¹ It should be noted, however, that nearly all of the Arctic species are well known forms belonging to the 'Holarctic Province' of authors, and that these species are of practically continuous distribution on all coasts in northern regions so far as explored.

In the same paper, Dr. Dall divides the coasts of America from Monterey, California, north and west, into three faunal areas, as follows: (a) the *Oregonian*, extending from Monterey to the Shumagin Islands; (b) the *Aleutian*, extending from the Shumagin Islands to the end of the Aleutian chain, and northward to the winter line of floating ice in Bering Sea; (c) the *Arctic*, limited on the shore line to the winter line of floating ice and passing southward indefinitely in deep water.

This paper deals chiefly with what Dr. Dall would call the Oregonian Fauna, only seven species having been secured to the westward of the Shumagin Islands. Of these seven species five are also found in his Oregonian Fauna, and the other two are new and known, thus far, from only one locality.

Dr. Clark, in reporting on the collection made by Dr. Dall, enumerates 25 species that occur west and north of the Shumagin Islands. Of these 25 species we now know that sixteen

¹ Proc. Acad. Nat. Sciences, Philadelphia, p. 206, 1876.

also occur to the eastward of the Islands, while five have not been reported from any locality other than the ones where they were originally discovered. Our present knowledge therefore does not support the validity of Dr. Dall's division of faunæ at the Shumagin Islands. It rather indicates a continuity of fauna from southern Alaska to the end of the Aleutian chain. Hydroid life appears to decrease as we go westward, but this may be only apparent and due to the more extensive exploration of the shores east of the Aleutian Islands.

Dr. Dall extends his *Oregonian* fauna down to Monterey, California. Reasoning again merely from the known distribution of hydroids, it would seem that Puget Sound is a natural region of demarcation between faunæ, although the region from Puget Sound to San Francisco has been very little explored. In 1876 Dr. Clark published a paper on 'The Hydroids of the Pacific Coast of the United States south of Vancouver Island,'¹ in which he gives a list of twenty-four species; of these only two, *Lafæa dumosa* and *Sertularia argentea*, have as yet been reported north of Puget Sound. The same author, in reporting on Dr. Dall's collections from Alaska, notes as one of the main points of interest, the "small number of species that are common to the Alaskan coast and the western shores of the United States from Vancouver Island southward."² In 1899 the present writer published a paper on 'Hydroida from Alaska and Puget Sound'³ in which it appears that out of twenty-two species from Puget Sound, only four have been reported farther south, while fifteen are now known to occur in Alaska. In the same year Mr. G. N. Calkins published a paper entitled 'Some Hydroids from Puget Sound,'² in which some thirty species are noted, only two of which are known to occur south of Puget Sound.

From this study of the distribution of the Hydroids of the northwest coast of America, therefore, I am strongly persuaded that the region *south* of Puget Sound constitutes one distinct faunal area, and that the region from Puget Sound north and west to the end of the Aleutian chain constitutes another un-

¹Trans. Conn. Acad. Sci., Vol. III, pp. 250-251, 1876.

²Proc. Acad. Nat. Sciences, Philadelphia, p. 212, 1876.

³Proc. U. S. Nat. Museum, Vol. XXI, No. 1171, 1899.

⁴Proc. Bost. Soc. Nat. Hist., Vol. XXVIII, No. 13, 1899.

Proc. Wash. Acad. Sci., May, 1901.

broken faunal area that might properly be designated as *Alaskan*. From the number of arctic species included in this area it is not improbable that it extends northward along the shores of Bering Sea.

Dr. Clark agrees with Dr. Dall that there is a distinct faunal difference between the region east of the Shumagin Islands and that west of them. The material added since the publication of his paper, however, seems to prove that this difference is only apparent and due solely to lack of exploration.

The most important thing to be noted in that part of the table devoted to general distribution is the Holarctic distribution of a number of species. Of the eighteen species known to occur in the Arctic region, no less than fifteen also occur on the European coast, fourteen on the Atlantic coast of the United States, and thirteen on the Pacific coast as far south as Puget Sound. An examination of the table shows further, that the Hydroid fauna of Alaska, as represented by the Harriman collection, includes fifty-three species in all, of which eighteen are Arctic in fact, having been secured in Arctic waters; four others are in all probability Arctic, being found both in European and American waters; four are, so far as is known, confined to the Alaskan and Pacific coast south to Puget Sound; twenty-five are thus far known from Alaska only, and two are Californian. If we recognize the Alaskan faunal region as extending to Puget Sound, and include those species actually known to be Arctic, together with those in all probability Arctic, in a group which may justly be called Arctic, the following significant analysis of the faunal relations of the collection may be made: Alaskan species, twenty-nine; Arctic species, twenty-two; Californian species, two. This shows that fifty-five percent of the hydroid fauna as a whole is peculiar to Alaska, but that there has been a strong invasion from the Arctic regions of the Holarctic species constituting about forty-one percent of the collection, and that only two species, or less than four percent, are Californian. If all the species known to occur in Alaska were included in the computation the result would be a larger percentage of Alaskan species, a corresponding decrease of the Arctic species, and the addition of one or two Californian species.

SYSTEMATIC DISCUSSION.

The writer deems it unnecessary to attempt a complete synonymy of the well known European species contained in the Harriman collection and considers it sufficient to give, *first*, and in all cases, the original reference to the species; *second*, all obtainable references to the occurrence of the species on the Pacific Coast of America, and, *third*, a reference to verify the 'General Distribution' as given in the table just discussed. In this latter case only one reference will be given to verify the occurrence of a given species in each of the regions included in the right hand portion of the table.

As to the classification employed in this report, it seems best, on the whole, to pursue a conservative course, following pretty closely the lines laid down by the able British naturalists, Hincks and Allman. While it is true that the classification is in an unsatisfactory state, the writer does not feel that a thorough revision of the entire group of Hydroida should be attempted here, and frankly confesses his conviction that recent attempts in that direction have not been successful, though each contains valuable suggestions. Levinsen, for example, has made a notable contribution to our knowledge of the Campanulinidæ in his able and careful exposition of the differences in the opercula of various species, but his genera founded solely on these structures appear to be artificial, as usually happens when a single character is made the basis of classification.¹ In his terse characterization of the genera of Sertularidæ this author has been most fortunate, as well as in his masterly clearing up of the mystery concerning the gonosome of *Lafwa*.

Schneider,² also, has attempted to rearrange the Hydroida on a logical basis. Instead of multiplying groups, as has been the tendency of late, he has, in my opinion, gone far to the other extreme, uniting families that almost any other student acquainted with the group would regard as surely distinct. It seems unlikely that he will be followed in uniting such groups as the Tubularidæ and Pennaridæ in a single family, although one

¹ Meduser, Ctenophorer og Hydroider fra Grönlands Vestkyst, Copenhagen, 1893.

² Hydropolypen von Rovigno, nebst übersicht über das system der hydro-polypen in allgemeinen. Zool. Jahrb., Syst. Abth., Vol. x, 1897.

writer, Calkins,¹ has followed his classification quite closely, and includes representatives of what would ordinarily be regarded as at least eleven families in five families as defined by Schneider.

It is not likely that classifications will ever represent anything but individual opinion, and it is probable that there will always be two sets of extremists who on the one hand will be too ready to multiply groups, and on the other will be too conservative to recognize real progress. The Hydroida offer unusual difficulties and consequently students of that group find agreement, even along the most general lines, practically impossible. The objective point of systematic discussion has been the attainment of a system of classification by which genera could be distinguished by means of the trophosome alone. This end, although in theory greatly to be desired, appears to be unattainable. The writer has chased this will-o-the-wisp for years, and is ready to abandon its pursuit as unprofitable. Abler men have had the same experience, and it appears to be pretty well established that in practice we must base generic distinctions on the gonosome alone, although the judgment of students will inevitably differ as to the extent to which this can be profitably done. Botanists have encountered the same difficulty in their study of the lower plants, such as the fungi, and have come to the same conclusion. In neither case has nature been working for the convenience of naturalists, and the fact should be accepted without a bootless chase after the unattainable.

GYMNOBLASTEÆ.

Hydroida in which well differentiated hydrothecæ and gonangia are not present. What might be called 'pseudo-hydrothecæ' are found in some species as in *Eudendrium vaginatum* (see description of that species on pages 167-168).

Family *CORYNIDÆ.*

Trophosome.—Hydranth with a terete body and proboscis and scattered capitate tentacles only.

Gonosome.—Fixed sporosacs, or free medusæ with a very long manubrium, four marginal tentacles and four sense-bulbs with eye-spots.

¹Some Hydroids from Puget Sound, Proc. Bost. Soc. Nat. Hist., Vol. XXVIII, No. 13, 1899.

CORYNE.

Trophosome.—Characters of the family.

Gonosome.—Reproductive elements produced in fixed sporosacs growing on the hydranth body.

CORYNE BRACHIATA sp. nov.

(Plate xiv, figs. 1, 2.)

Trophosome.—Colony forming a dense tuft of irregularly branching stems, sometimes attaining a height of about $\frac{3}{4}$ inch. Stems and branches profusely and regularly annulated throughout, fairly stout except at the proximal ends where they taper gradually to their point of origin; distal ends of many of the branches bear a more or less regular whorl, or radiating cluster, of annulated branchlets just below the hydranth body, reminding one of the whorls of cirri around the stems of the stalked crinoids. Hydranths large, with long, slender body and proboscis and numerous (20–35) capitate tentacles arranged in a scattered or sub-verticillate manner over nearly the whole surface.

Gonosome.—Gonophores very numerous, borne among the tentacles on the hydranth bodies, globular in outline and showing no traces of radial canals or other medusoid structures. The specimens secured were females and the gonophores were packed full of developing ova.

Distribution.—All the specimens were secured in Yakutat Bay, Alaska, by Dr. W. R. Coe of the Harriman Expedition.

This interesting species seems to be nearest to *C. pusilla* Gaertner, if Allman has properly identified that species. It differs from other members of the genus in the curious whorl of short branchlets which bear neither hydranths nor gonophores and are situated a short distance below the terminal hydranth of the stem or branch to which they are attached. Another character not shown in the figures of this genus published by Hincks and Allman, is the narrowing at the proximal ends of the stems and branches. The specimens were found immersed in sponge so far that only the hydranths extended above the surface of the sponge.

SYNCORYNE.

Trophosome.—Characters the same as those given for the family.

Gonosome.—Reproductive elements produced in free medusæ with a long manubrium and four marginal tentacles, each having a sense bulb with an eye-spot at its base.

SYNCORYNE EXIMIA Allman.

(Plate XIV, figs. 3, 4.)

Coryne eximia ALLMAN, Annals and Mag. Nat. Hist., 3d Series, Vol. IV, p. 141. Aug., 1859.

Syncoryne eximia ALLMAN, Annals and Mag. Nat. Hist., 3d Series, Vol. XIII, p. 357. May, 1864.

This appears to be the first record of the occurrence of this species in American waters. There are many specimens in the collection, but all are from the same locality.

Distribution.—Juneau, Alaska (Harriman Expedition); Great Britain (Allman and Hincks); Lofoten Islands, Norway (Sars).

Family BIMERIDÆ.

Trophosome.—Hydranths with a conical or dome-shaped proboscis, around the base of which is a whorl of filiform tentacles.

Gonosome.—Sexual products developed in fixed sporosacs.

GARVEIA.

Trophosome.—Colony branched; perisarc conspicuous.

Gonosome.—Gonophores borne on distinct branchlets which have a chitinous investment ending in a cup-like expansion just below the gonophore.

GARVEIA NUTANS Wright.

Garveia nutans WRIGHT, Edinburgh New Phil. Jour., p. 109. July, 1859.
Eudendrium bacciferum ALLMAN, Annals and Mag. Nat. Hist., 3d Series, Vol. IV, p. 52, July, 1859.

This is another species that has not before been reported from American waters. The specimens were fragmentary, making the identification somewhat uncertain, although I have little doubt of its correctness.

Distribution.—Berg Inlet, Glacier Bay, Alaska. (Harriman Expedition.) Originally described from the British Coast.

GARVEIA ANNULATA sp. nov.

(Plate xv, figs. 1, 2.)

Trophosome.—Colony attaining a height of 1½ inches, consisting of a number of closely aggregated and sparingly and irregularly branched stems. Stems strongly and evenly annulated throughout, the perisarc expanding distally into thin chitinous pseudo-hydrothecæ which cover the hydranth body nearly to the level of the tentacles. Hydranths with

a conical, or rather conoid, proboscis and about sixteen tentacles all of which appear to be held more or less erect.

Gonosome.—Gonophores borne either on the stem or hydrorhiza, more frequently the latter, oval in shape, borne on pedicels enveloped in a chitinous perisarc which ends in a slightly expanded collar a little below the gonophore. The specimens collected were female and the gonophores were packed with apparently mature ova.

Color.—The label accompanying the specimens bore the following statement: "Bright orange throughout, heads, stems and all."

Distribution.—Yakutat and Sitka, Alaska. Collected by the Hariman Expedition in considerable quantities.

This species can be sharply distinguished from its British relative by the very distinct and beautiful annulation which covers the entire stem and branches. It is much less extensively branched than the British species, and the gonophores are more generally borne on the roots.

The structure that I have designated above as a 'pseudo-hydrotheca' is of considerable morphological interest, for it may throw light on the origin of the hydrotheca. The extension of the chitinous perisarc of the stem over the body of the hydranth appears to be attached to the latter. A true hydrotheca would be formed if the perisarc around the hydranth body should become thicker and detached.

Family *EUDENDRIDÆ*.

Trophosome.—Colony branching. Hydranths with a single whorl of filiform tentacles and a trumpet-shaped or hemispherical proboscis which is expanded distally and contracted proximally, thus being sharply distinguished from the hydranth body.

Gonosome.—Reproductive elements developed in fixed sporosacs attached to a usually more or less degenerated hydranth body below the tentacles.

This family contains but one genus, *Eudendrium*, which needs no further definition.

EUDENDRIUM VAGINATUM Allman.

(Plate xv, figs. 3-6.)

Eudendrium vaginatum ALLMAN, Annals and Mag. Nat. Hist., Third Series, Vol. XI, p. 10, Jan., 1863.

As the gonosome of this species has not heretofore been described, the following is inserted here:

Gonosome.—Gonophores (female) in dense clusters around the bodies of hydranths that are usually devoid of tentacles. Each gono-

phore is borne on a pedicel which resembles those of *Garveia*, having a distinct expanded collar a short distance below the hydranth.

Distribution.—Sitka Harbor and Yakutat, Alaska, abundant (Harriman Expedition); Shetland Island, Scotland (Allman).

This beautiful species bears considerable resemblance to *Eudendrium annulatum* Allman, especially in its gonosome which Allman describes as follows: "The gonophores are grouped in clusters, consisting of from eight to twenty egg-shaped bodies attached around the axis of gonoblastidea, which are of moderate length."¹

Were it not for a peculiar character of the trophosome, *i. e.*, the expanded pseudo-hydrotheca investing the body below the tentacles much as in *Garveia*, there might be some suspicion that *E. vaginatum* and *E. annulatum* are synonyms, particularly in view of the fact that both were described from the Shetland Islands.

It also seems not improbable that *Eudendrium pygmaeum* Clark² may be another synonym of *E. vaginatum*, as Clark's description of the gonosome agrees well with the gonosome described above. If this be true, it is also likely that the dried stems described by Clark from Santa Cruz, California, will be found to belong to this same species.

Family TUBULARIDÆ.

Trophosome.—Hydranths large, with a basal whorl of filiform tentacles and a distal set of closely crowded shorter filiform tentacles.

Gonosome.—Reproductive elements developed in sessile medusæ borne in clusters just above the basal tentacles and producing actinules instead of planulæ.

TUBULARIA.

The only genus included in the family in the sense here used.

TUBULARIA HARRIMANI sp. nov.

(Plate xvi.)

Trophosome.—Stem usually unbranched, attaining a height of 1½ inches, irregularly and sparingly annulated and increasing in size from the proximal to the distal end, but more rapidly on the basal portion; a marked constriction some distance below the hydranth body; stem canaliculated between the constriction and the hydranth. Hydranth with forty to fifty basal tentacles and about twenty in the distal set.

Gonosome.—Gonophores borne in about twelve very long and densely crowded racemes, which are supported by long, tentacle-like

¹ Ann. and Mag. Nat. Hist., 3d Series, Vol. XIII, p. 83, Jan., 1864.

² Proc. Acad. Nat. Sciences, Philadelphia, p. 232, 1876.

pedicels arising above the proximal row of tentacles. Gonophores (female) with three to five long tentacular processes which are sometimes half the length of the gonophore. The actinule at birth is without a distal row of tentacles, and the gonophore has no indication of radial canals.

Distribution.—Orca, Prince William Sound, Alaska (W. E. Ritter).

Exclusive of this species there have now been described four species of *Tubularia* from the Pacific Coast of North America; *Parypha microcephala* (A. Agassiz),¹ which differs from the present species in having flattened, instead of round, tentacular processes to the gonophores; *Tubularia elegans* Clark,² which has mere tubercles instead of the filiform processes to the gonophores; *Tubularia borealis* Clark,³ which differs in having laterally compressed processes to the gonophores; and *Tubularia larynx* Ellis and Solander⁴ (reported by Gary S. Calkins), which differs from *T. harrimani* in the number of both proximal and distal sets of tentacles, as well as in several other characters.

The species seems to be abundant at Orca, as numerous specimens were found.

CALYPTEROBLASTEÆ.

Hydroids in which hydrothecæ are developed for the protection of the hydranths and gonangia for the protection of the gonophores.

Family CAMPANULARIDÆ.

Trophosome.—Hydrothecæ well developed, non-operculate, never adnate nor immersed in the stem and always with a septum partially dividing the hydrothecal cavity from the stem cavity. Hydranths usually with conical proboscis and a single whorl of filiform tentacles.

Gonosome.—Gonophores producing planulæ or free medusæ.

It would be hard to find two authorities who would agree as to the genera of this exceedingly perplexing family. The arrangement here adopted is substantially the same as that used by the writer in another work now in press.⁵ It is not offered as a final solution of the difficulty, but as a convenience in discussing the group in the present connection.

¹ North American Acalephæ, p. 195.

² Transactions Conn. Acad. Sci., Vol. III, p. 253, 1876.

³ Proc. Acad. Nat. Sci. Philadelphia, p. 231, 1876.

⁴ Proc. Boston Soc. Nat. Hist., Vol. XXVIII, No. 13, p. 335.

⁵ Handbook of the Hydroids of the Woods Hole Region. To be published by the U. S. Fish Commission.

CLYTIA.

Trophosome.—Stem not regularly branched. Hydrothecæ with toothed margins, or with excessively thick walls and with long pedicels.

Gonosome.—Reproduction by means of free medusæ.

CLYTIA CALICULATA (Hincks).

(Plate xvii. figs. 1, 2.)

Campanularia caliculata HINCKS, Annals and Mag. Nat. Hist., 2nd ser., Vol. XI, p. 178, March, 1853.—VERRILL, Preliminary check-list of Marine Invertebrates of Atlantic Coast, etc., p. 16, 1879.—MARKTANNER-TURNERETSCHER, Hydroiden von Ost-Spitzbergen, Zool. Jahrb., Vol. VIII, p. 406, 1895.—CALKINS, Some Hydroids from Puget Sound, Proc. Boston Soc. Nat. Hist., Vol. XXVIII, No. 13, p. 351, 1899.

Some authors, as Levinsen, regard this species as identical with *C. integra* Macgillivray. The mode of reproduction is so different, however, that the two would go into different genera in the classification here adopted.

Distribution.—Yakutat, Alaska (Harriman Exped.); British Coast (Hincks); Spitzbergen (Marktanner-Turneretscher); New England Coast (Verrill); Puget Sound (Calkins).

CLYTIA COMPRESSA (Clark).

(Plate xvii. figs. 3, 4.)

Campanularia compressa CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 214, 1876.

Eucopella campanularia (VON LENDENFELD)? Über Coelenteraten der Sudsee, IV, Mitth. Zeitsch. Wiss. Zool., XXXVIII, p. 497, 1883.

Distribution.—Orca, Alaska (Harriman Exped.); Shumagin Islands (Clark). The figures given of this species well illustrate the great variation in thickness of the hydrothecal walls. All the specimens thus far discovered were found attached to *Laminaria*, over which they creep in great profusion.

Von Lendenfeld makes his *Eucopella campanularia* the subject of one of his masterly monographic papers and it appears to agree in every particular with the species under discussion. If I am correct in supposing the two species identical, the name *Eucopella campanularia* will become a synonym and a very exceptional distribution will be recorded for *Clytia compressa*. It is interesting to note that von Lendenfeld's species was also found growing on *Laminaria*.

The present writer does not agree with Calkins in his suggestion that *C. compressa* is a synonym of *C. caliculata*.

CAMPANULARIA.

Trophosome.—Colony unbranched or regularly branched; stem simple or fascicled; hydrothecæ campanulate, never completely sessile nor with operculum.

Gonosome.—Gonophores producing planulæ without the intervention of medusæ.

CAMPANULARIA VERTICILLATA (Linn.)

Sertularia verticillata LINN., Syst. Nat., 10th ed., p. 811, 1758.

Campanularia verticillata SARS, Bidrag til Kundskaben om Norges Hydroider, p. 46, 1873.—VERRILL, Preliminary check-list of Marine Invertebrates of Atlantic Coast, p. 16, 1879.

Distribution.—Kadiak, Alaska (Harriman Exped.); North Cape, Norway (Sars); New England Coast (Verrill).

CAMPANULARIA DENTICULATA Clark.

Campanularia denticulata CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 213, 1876.

Distribution.—Orca, Alaska (Harriman Exped.); Port Etches, Alaska (Clark).

CAMPANULARIA LINEATA Nutting.

Campanularia lineata NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 744, 1899.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Harriman Exped.); Puget Sound (Nutting).

CAMPANULARIA RITTERI sp. nov.

(Plate xvii, fig. 5.)

Trophosome.—Colony usually consisting of unbranched pedicels growing directly from a creeping rootstock. Pedicels long and slender, usually with a single distinct annulation at the distal end just below the hydrotheca and about three less distinct ones at the proximal end, the middle portion not being annulated. Hydrothecæ cylindrical, large, delicate in structure and with a perfectly even rim.

Gonosome.—Unknown.

Distribution.—Juneau, Alaska, 20 fathoms. Collected by Prof. Wm. E. Ritter to whose efforts the fine series of Hydroids here discussed is so largely due, and for whom this species is named.

CAMPANULARIA SPECIOSA Clark.

(Plate xviii, fig. 3, Plate xix, fig. 3.)

Campanularia speciosa CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 214, 1876.—LEVINSEN, Meduser, Ctenophorer og Hydroider fra Grönlands Vestkyst, p. 25, 1893.

Campanularia crenata ALLMAN, Diagnoses of new Genera and Species of Hydroida, Linnæan Society Journal, Zoology, Vol. XI, p. 258, 1876.

Distribution.—Orca, Alaska (Harriman Exped.); Yukon Harbor, Big Koniuiji, Shumagin Islands, Alaska (Clark); Japan Coast (Allman); Greenland (Levinsen).

CAMPANULARIA URCEOLATA Clark.

(Plate XVIII, fig. 2.)

Campanularia urceolata CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 215, 1876.

Distribution.—Yakutat Bay, Alaska (Harriman Exped.); Lituya Bay, Alaska (Clark).

The specimens collected by the Harriman Expedition were growing profusely over the stems and branches of *Thuiaria costata* in company with another parasitic species.

CAMPANULARIA REDUPLICATA sp. nov.

(Plate XVIII, fig. 1.)

Trophosome.—Colony consisting of unbranched stems or pedicels springing from a creeping rootstock. Pedicels one to three times as long as the hydrothecæ, and strongly annulated throughout. Hydrothecæ deeply campanulate, thick-walled; margins armed with twelve to fourteen rather pointed teeth, and reduplicated once or twice, giving a striking and unusually ornate appearance.

Gonosome.—Gonangia roughly ovate, irregular in outline, with a short neck, small terminal aperture and a very short pedicel. They were empty in the specimens examined, so that it was impossible to ascertain whether they produced planulæ or medusæ.

Distribution.—Yakutat, Alaska (Harriman Exped.). All the specimens were found growing in a parasitic manner over colonies of *Thuiaria costata*, in company with *Campanularia urceolata*. The two species were often so intimately interwoven as they crept over the stems and branches of the sertularian that I, at first, thought them dimorphic forms of one species. However, in all cases careful dissection showed that they were entirely separate colonies. The reduplication of the hydrothecal margins seems to be a constant feature and adds peculiar beauty to this striking little campanularian.

CAMPANULARIA REGIA sp. nov.

(Plate XIX, figs. 1, 2.)

Trophosome.—Colony consisting of a creeping rootstock without annulations, giving forth strong pedicels that are sometimes longer

than the hydrothecæ and sometimes considerably shorter, without a definite swelling below the hydrothecæ. Hydrothecæ immense, in one case nearly $\frac{3}{32}$ of an inch in height, long, tubular-urceolate, expanded distally, with slightly everted and broadly sinuous margin. The margin is reduplicated in one specimen. Hydranth with about twenty tentacles.

Gonosome.—Not known.

Distribution.—Orca, Prince William Sound, Alaska (W. R. Coe, Harriman Exped.).

This species is closely allied to *C. grandis* Allman,¹ and may be identical with it although it differs from Allman's description in the character of the pedicels which he describes as having distinct node-like enlargements immediately below the hydrothecæ. The hydrothecæ are larger than those of any other campanularian known to me. But one small colony was found and it was creeping over another hydroid.

OBELIA.

Trophosome.—Colony regularly branching; stem simple or compound. Hydrothecæ campanulate, thin, never with greatly thickened walls.

Gonosome.—Reproduction by means of medusæ which are disk-shaped, with four radial canals, more than eight marginal tentacles, eight interradial lithocysts and a short manubrium without mouth tentacles.

OBELIA DICHOTOMA (Linn.).

Sertularia dichotoma LINN., Systema Naturæ, Ed. x, p. 812. 1758.

Obelia dichotoma SCHULZE, Nordsee Expedition, Hydroida, p. 129, 1872.—

VERRILL, Preliminary check-list Marine Invertebrates of Atlantic coast, p. 16, 1879.—CALKINS, Some Hydroids from Puget Sound, Proc. Boston Soc. Nat. Hist., Vol. XXVIII, No. 13, p. 256, 1899.

Distribution.—Sitka, Berg Inlet, and Orca, Alaska (Harriman Exped.); British Coast (Hincks); Helgoland (Schulze); Puget Sound (Calkins).

OBELIA PLICATA Hincks.

Obelia plicata HINCKS, British Hydroid Zoophytes, p. 159, 1868.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, No. 13, p. 741, 1899.

Distribution.—Orca, Alaska (Harriman Exped.); Puget Sound (Nutting); British Coasts (Hincks).

¹Diagnoses of new Genera and Species of Hydroida; Linnæan Soc. Jour. Zoology, Vol. XI, p. 259.

OBELIA BOREALIS sp. nov.

(Plate XIX, figs. 4, 6.)

Trophosome.—Colony sometimes attaining a height of eighteen inches, but usually much shorter; stem not truly fascicled, although several stems may be interwoven, exceedingly long and slender, sinuous, giving off lateral branches in pairs on proximal portion and more often singly on distal portion; branches with a strong tendency to verticillate arrangement, forming oblique angles with the stem and divided into numerous branchlets in a flabellate manner. Pedicels short and completely annulated, or long and annulated only at ends, set on broad shoulders of the stem. Hydrothecæ funnel-shaped, the sides usually straight, aperture with an even rim. Hydranths not well preserved in specimens examined.

Gonosome.—Gonangia borne in axils of branches and branchlets, oblong-ovate, truncated above, having a collar in mature specimens; aperture apparently very large, pedicels strongly annulated. The gonangia of the specimens examined were filled with developing medusæ of the regular Obelia type.

Distribution.—Yakutat, Alaska (Harriman Exped.).

This fine species is related to *O. flabellata*, but the hydrothecæ are much deeper than in *O. flabellata*, in which they are sub-triangular in outline. It also bears some resemblance to *O. commissuralis*, which, however, is a much more delicate species, with smaller and more campanulate hydrothecæ.

OBELIA DUBIA sp. nov.

(Plate XX, fig. 1.)

Trophosome.—Colony attaining a height of about $\frac{3}{4}$ inch; stem sparingly branched, the main stem and larger branches sinuous or slightly geniculate, giving forth pedicels singly or in opposite pairs at the bends. Pedicels rather long and annulated throughout, the stem also more extensively annulated than in most species of the genus. Hydrothecæ very large, deep, tubular, with very shallow undulations around the margin, from between which lines run down for a short distance on the surface of the hydrothecæ.

Gonosome.—Unknown.

Distribution.—Orca, Alaska (Harriman Exped.).

This species bears some resemblance to *O. bidentata* Clark, found on the New England Coast, but differs in the nature of the hydrothecal teeth which are mere sinuosities, instead of being mucronate with two denticles each as in the latter species.

HEBELLA.

Trophosome.—Pedicels arising from a creeping rootstock, very short. Hydrothecæ tubular, with entire margins, without opercula, and having their cavities separated from those of the stems by a partial septum. Hydranths with a conical proboscis.

This genus was originally instituted by Allman.¹ As here defined it includes several species heretofore included in the genus *Lafæa*.

HEBELLA POCILLUM (Hincks).

Lafæa pocillum HINCKS, British Hydroid Zoophytes, p. 204, 1868.—CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 215, 1876.—VERRILL, Preliminary check-list Marine Vertebrates of Atlantic coast, p. 17, 1879.—BERGH, Goplepolyper (Hydroider) fra Kara-Havet, p. 333, 1887.

Distribution.—Kadiak, Alaska (Harriman Exped.); Nunivak Island, Alaska (Clark); Kara Sea (Bergh); British Coasts (Hincks); New England Coast (Verrill).

GONOTHYRÆA.

Trophosome.—Much as in *Obelia*.

Gonosome.—Planulæ produced in sessile medusaform gonophores which remain attached to the top of the gonangia until the spermatozoa or planulæ are discharged.

GONOTHYRÆA INORNATA sp. nov.

(Plate xx, figs. 2-4.)

Trophosome.—Colony attaining a height of about two inches and consisting of a main stem which almost immediately breaks up into a number of very slender, erect, almost straight branches which are ornamented with about three annulations immediately above the origins of the pedicels. Pedicels alternate, erect, much broader below than above and with seven to ten annulations. Hydrothecæ funnel-shaped, with entire margins.

Gonosome.—Gonangia borne in the axils of the pedicels, slender, obconic, with a tendency to annulation. Each gonangium contains a single sporosac which when mature rests upon the summit of the gonangium and has little indication of radial canals or tentacles.

Distribution.—Yakutat Bay, Alaska (Harriman Exped.).

This species differs from others of the genus in having but one sporosac to each gonangium and in the obliteration of most of the medusoid characters of the sporosac. The entire margin of the hydrotheca is also an exceptional character.

¹ Allman, Challenger Report, Hydroida, Second Part, p. 29, 1888.

Family *CAMPANULINIDÆ*.

Trophosome.—Colonies branched or unbranched. Hydrothecæ borne on pedicels, tubular, ending in an operculum composed of several converging segments or triangular flaps. Hydranth with a conical proboscis.

Gonosome.—Gonangia producing free medusæ or planulæ.

CAMPANULINA.

Trophosome.—Hydrothecæ thin-walled, the upper portion cleft so as to produce very long and slender teeth which form an operculum by the convergence of their free ends.

Gonosome.—Gonangia producing bell-shaped medusæ, with four radial canals, two or four marginal tentacles, and eight lithocysts.

CAMPANULINA RUGOSA sp. nov.

(Plate XXII, figs. 1, 2.)

Trophosome.—Colony attaining a height of about $\frac{1}{2}$ inch. Stem irregularly branched; branches tending to an alternate arrangement, straggling, geniculate; stem and branches strongly and regularly annulated throughout. Pedicels very short, with three to six annulations. Hydrothecæ ovoid-oblong, the distal third being composed of the operculum consisting of ten or twelve segments. The hydranths have about sixteen tentacles.

Gonosome.—Gonangia in axils of the pedicels and branches, sometimes aggregated on certain branches to the exclusion of hydrothecæ. They are oblong-ovoid in shape and somewhat flattened on their distal ends. Each gonangium contains a single medusa when mature.

Distribution.—Juneau, Alaska (Harriman Exped.). The specimens were found growing on *Obelia*.

CALYCELLA.

Trophosome.—Stem a creeping rootstock sending forth short annulated pedicels. Hydrothecæ tubular, thick-walled, with opercula that are distinct from the hydrothecal teeth, and composed of several triangular segments.

Gonosome.—Gonangia borne on the rootstock, and, when mature, bearing acrocysts.

CALYCELLA SYRINGA (Linn.).

Sertularia syringa LINN., Systema Naturæ, Ed. XII, Tom. I, Pars II, p. 1311, 1767.

Calycella syringa CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 210, 1876.—VERRILL, Preliminary Check-list Marine Invertebrata Atlantic Coast, p. 17, 1879.—BERGH, Goplepolyper (Hydroider) fra Kara-Havet, p. 335, 1887.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Berg Inlet and Kadiak, Alaska (Harriman Exped.); Coal Harbor, Shumagin Islands, Alaska (Clark); Kara Sea (Bergh); British Coasts (Hincks); New England Coast (Verrill); Puget Sound (Nutting).

Family LAFŒIDÆ.

Trophosome.—Hydrothecæ tubular, margins without teeth or opercula, the hydrothecal cavity not divided from the stem cavity by a partial septum.

Gonosome.—Gonangia forming a ‘Coppinia’ mass.

LAFŒA.

Trophosome.—Colony with a fascicled stem, and with hydrothecæ either free or partially immersed in the stem, the distal portion not being abruptly turned upward.

Gonosome.—A ‘Coppinia’ mass.

LAFŒA DUMOSA (Fleming).

Sertularia dumosa FLEMING, Edinburgh Phil. Jour., II, p. 83, 1828.

Lafæa dumosa SARS, Bidrag til Kundskaben om Norges Hydroider, p. 45, 1873.—CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 210, 1876.—VERRILL, Preliminary Check-list Marine Invertebrates of Atlantic Coast, p. 17, 1879.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Dutch Harbor, Unalaska (Harriman Exped.); Port Etches, Alaska (Clark); North Cape, Norway (Sars); British Coast (Hincks); New England Coast (Verrill); Puget Sound (Nutting); California Coast (Clark).

LAFŒA GRACILLIMA (Alder).

Campanularia gracillima ALDER, Catalogue Zoophytes of Northumberland and Durham, Trans. Tyneside Naturalists' Field Club, p. 39, 1857.

Lafæa gracillima CLARK, Proc. Acad. Nat. Sciences, Philadelphia, p. 216, 1876.—VERRILL, Preliminary Check-list Marine Invertebrates of Atlantic Coast, p. 17, 1879.—MARKTANNER-TURNERETSCHER, Hydroiden von Ost-Spitzbergen, Zoolog. Jahrbuch., Vol. VIII, p. 410, 1895.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Juneau, Berg Inlet and Orca, Alaska (Harriman Exped.); Shumagin Islands, Alaska (Clark); British Coast (Alder);

Proc. Wash. Acad. Sci., May, 1901.

Spitzbergen (Marktanner-Turneretscher); New England Coast (Verrill); Puget Sound (Nutting).

LAFCEA FRUTICOSA M. Sars.

Lafœa fruticosa M. Sars, Bemærkninger over 4 norske Hydroider Vid. Selsk. Forh., 1862.—G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 26, 1873.—CLARK, Proc. Acad. Nat. Sciences, Phila., p. 216, 1876.

Distribution.—Juneau, Berg Inlet and Kadiak, Alaska (Harriman Exped.); Kiska Harbor, Shumagin Islands, Alaska (Clark); British Coasts (Hincks); Lofoten, Norway (G. O. Sars); New England Coast (Verrill); Puget Sound (Nutting, MSS.).

LAFCEA ADILÆRENS sp. nov.

(Plate XXI, figs. 3, 4.)

Trophosome.—Colony forming an encrusting mass of adherent rootstocks disposed both longitudinally and transversely over colonies of other Hydroids, the tubes of the rootstock interwoven much like the threads of a fabric. Hydrothecæ sessile, tubular, often more or less curved, aperture facing upward, entire; margin slightly expanded. The hydrothecæ are very irregularly disposed, being much more crowded in some places than in others.

Gonosome.—The ‘Coppinia’ mass is much like that of *Lafœa dumosa*, being composed of closely packed gonangia interspersed with long, tubular, variously curved modified hydrothecæ. The gonangia are flask-shaped, with a tubular neck and small aperture. Each gonangium apparently contains a single ovum.

Distribution.—Kadiak Harbor, Alaska. Growing over stems of *Thuiaria turgida* (Harriman Exped.).

This interesting species is so different in appearance from the others of the genus that I was at first inclined to make it the type of a new genus.

GRAMMARIA.

Trophosome.—Stem fascicled, composed of an axial tube from which the hydrothecæ spring and to which they are partly adnate, completely enclosed by a definite number of peripheral nonhydrothecate tubes.

Gonosome.—A ‘Coppinia’ mass.

GRAMMARIA IMMERSA sp. nov.

(Plate XXI, figs. 5, 6.)

Trophosome.—Stem rigid, erect, giving forth scattered, stiff and straight, alternate branches forming nearly a right angle with the stem.

Height of a fragmentary specimen about $\frac{3}{4}$ inch. Stem and branches sharply constricted proximally, composed of an axial tube which gives off the eight or nine series of hydrothecæ, and a number of peripheral tubes enclosing the axial tube completely, thus burying all the hydrothecæ nearly to their distal ends. Hydrothecæ arranged in about eight or nine longitudinal series, forming spirals. The distal ends of the hydrothecæ are abruptly bent outward, so that the round, even aperture is vertical. When the peripheral tubes are removed the hydrothecæ are seen to be long, tubular, doubly curved, narrowing proximally, but without true pedicels, and all springing from the axial tube.

Gonosome.—Unknown.

Distribution.—St. Paul harbor, Kadiak (Harriman Exped.).

FILELLUM.

Trophosome.—Stem a creeping, slender rootstock, parasitic on other hydroids, often forming a reticulate structure. Hydrothecæ curved, decumbent, and partly adherent; margin entire, without operculum.

Gonosome.—A ‘Coppinia’ mass.

FILELLUM SERPENS (Hassell).

Campanularia serpens HASSELL, Zoologist, No. 69, p. 2223.

Filellum serpens SARS, Bidrag til Kundskaben om Norges Hydroider, p. 29, 1873.—VERRILL, Preliminary Check-list Marine Invertebrates of Atlantic Coast, p. 17, 1879.

Distribution.—Juneau, Alaska (Harriman Exped.); British Coast (Hassell); Lofoten, Norway (Sars).

Family *HALECIDÆ*.

Trophosome.—Hydrothecæ reduced to the form of saucer-shaped or collar-like hydrophores, usually borne on broad tubular pedicels; margins even, often reduplicated. Hydranths large, incapable of retracting within the hydrophores, and with a conical or dome-shaped proboscis.

Gonosome.—Gonangia producing planulæ, and usually differing in the two sexes.

HALECIUM.

Trophosome.—No specialized defensive ‘persons’ developed.

Gonosome.—Female gonangia often surmounted by a pair of hydranths.

HALECIUM HALECINUM (Linn.).

Sertularia halecina LINN., Systema Naturæ, Ed. x, p. 809, 1758.

Halecium halecinum VERRILL, Preliminary Catalogue Marine Invertebrates Atlantic Coast, p. 17, 1879.—MARKTANNER-TURNERETSCHER, Hydroiden von Ost-Spitzbergen, p. 428, 1895.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Kadiak, Alaska (Harriman Exped.); British Coast (Hincks); Greenland (Marktanner-Turneretscher); New England Coast (Verrill); Puget Sound (Nutting).

HALECIUM MURICATUM (Ellis and Solander).

Sertularia muricata ELLIS AND SOLANDER, Nat. Hist. Zoophytes, p. 59, 1786.

Halecium muricatum VERRILL, Preliminary Check-list Marine Invertebrates Atlantic Coast, etc., p. 17, 1879.—LEVINSEN, Meduser, Ctenophorer og Hydroider fra Grönlands Vestkyst, p. 61, 1893.—CLARK, Proc. Acad. Nat. Sci., Philadelphia, p. 217, 1876.

Distribution.—Orca, Alaska (Harriman Expd.); British Coasts (Ellis and Solander); Greenland (Levinson); New England Coast (Verrill).

HALECIUM SCUTUM Clark.

Halecium scutum CLARK, Proc. Acad. Nat. Sci., Philadelphia, p. 218, 1876.
—BONNEVIE, Norwegian N. Atlan. Exped., p. 57, 1899.

Distribution.—Berg Inlet and Yakutat, Alaska (Harriman Exped.); Unalaska (beach) and Shumagin Islands, Alaska (Clark); North Cape, Norway (Bonnevie).

HALECIUM REVERSUM sp. nov.

(Plate XXIII, figs. 1, 2.)

Trophosome.—Colony attaining a height of about one inch. Main stem fascicled, branches simple and alternate, making a flabellate colony. Nonfascicled part of the stem and branches divided into internodes, each of which bears one or two pedicels springing from its *proximal* portion. Pedicels long, of even diameter throughout, often rugose on proximal portion. Hydrophores with large everted margins and a distinct row of dots. Reduplication of margins distant, when present. Hydranth small for this genus, with about twenty tentacles.

Gonosome.—Not present in type specimen.

Distribution.—Juneau, Alaska (Harriman Exped.).

This species possesses the very exceptional, if not unique, character of having the pedicels spring from the proximal part of the internode instead of the distal portion, as in all other species of *Halecium* with which I am acquainted. This character appears to be constant. The specimen was dredged from a depth of twenty fathoms.

HALECIUM ORNATUM sp. nov.

(Plate XXII, figs. 3, 4.)

Trophosome.—Colony parasitic, branching irregularly. Stems not fascicled, the stem and branches sparsely and irregularly annulated. Pedicels long, of equal diameter throughout. Hydrophores with broad, everted margins, occasionally reduplicated. Hydranth large, with twenty-four to thirty tentacles.

Gonosome.—A single apparently young gonangium was borne on a pedicel just below the hydrophore. It was in form a truncated and deeply annulated cone. Probably the mature gonangium would resemble that found in the next species.

Distribution.—Berg Inlet, Glacier Bay, Alaska. Growing on *Lafæa gracillima* (Harriman Exped.).

HALECIUM SPECIOSUM sp. nov.

(Plate XXII, figs. 1, 2.)

Trophosome.—Colony small, attaining a height of about $\frac{1}{3}$ inch. Stem not fascicled, the main stem and branches apparently formed of series of stout pedicels, each giving origin to another pedicel just below the hydrophore. The pedicels thus take the place of stem joints, bending alternately to the right and left, giving a geniculate appearance to the series. Pedicels broad, corrugated proximally and smooth distally. Hydrophores large, with broadly expanded but not everted margins, and a well marked row of dots. There appears to be no reduplication of the margins. Hydranths very large with twenty-four to thirty short tentacles, a broad oral disk occupied by the low dome-shaped proboscis.

Gonosome.—Gonangia borne on rather long annulated pedicels below the hydrophores, particularly on the upper part of the colony; regularly ovoid in outline, and evenly and beautifully annulated throughout.

Distribution.—Yakutat Bay, Alaska (Harriman Exped.).

This is the most strikingly ornamented species of *Halecium* known to the writer. Its manner of growth is exceptional, although not unknown among its allies, and the hydranth is more like the polyp of some actinozoon than of a hydroid. The gonangia are beautiful structures. They seemed to be filled with a granular, ovoid mass, probably a single large sporosac.

HALECIUM ROBUSTUM sp. nov.

(Plate XXIII. figs. 3, 4, 5.)

Trophosome.—Stem very thick and fascicled, consisting of an immense number of wavy tubes. In the single specimen collected, the main stem divides near its base into three heavy fascicled branches, which themselves branch and subdivide extensively, the fasciculation continuing nearly to the tips of the branches. The entire height of the colony is about three inches. The branching is so profuse that the arrangement of the internodes is obscure. The ultimate branches give off short pedicels and sessile hydrophores in what appear to be clusters or whorls. Pedicels short, tubular, ending in an exceedingly shallow hydrophore. Hydrophores reduced to a mere narrow rim, marked by the internal diaphragm and circle of dots, the only distinction between pedicel and hydrophore, as the margin of the latter is not appreciably everted. Most of the hydrophores are sessile, being set on mere shoulders of the branch from which they grow. The circle of dots can only be made out with great difficulty and the use of high magnification. Hydranths exceedingly numerous and large, covering the branches so as to almost entirely conceal them from view. Tentacles about twenty, surrounding a low conoid proboscis.

Gonosome.—Unknown.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Harriman Exped.).

This species bears some relation to *Halecium densum* Calkins,¹ but differs from that species in the hydrophores, which are not reduplicated and have straight, not everted, margins. The hydranths are so crowded that a branch resembles an expanded colony of *Alcyonaria*, and appears to be made up entirely of hydranths.

Family SERTULARIDÆ.

Trophosome.—Hydrothecæ sessile, more or less adnate by their side to the stem and branches upon which they grow; always in more than one longitudinal row on each branch, the arrangement usually biserial. Hydranth with a conical proboscis.

Gonosome.—Reproduction always by means of planulæ, which are developed within the gonangia. No medusæ.

SERTULARELLA.

Trophosome.—Stem and branches divided into regular internodes, each bearing one or two hydrothecæ; nodes oblique. Hydrothecæ

¹Proc. Boston Soc. Nat. Hist., Vol. 28, no. 13, p. 343, 1899.

alternate, borne on opposite sides of the stem and branches. Margin usually more or less toothed, aperture usually provided with an operculum consisting of more than one segment.

SERTULARELLA TRICUSPIDATA (Alder).

Sertularia tricuspidata ALDER, Catalogue of the Zoophytes of Northumberland and Durham, Trans. Tyneside Naturalists' Field Club, p. 21, 1857.
Cotulina tricuspidata A. AGASSIZ, North American Acalephæ, p. 146, 1864.
Sertularella tricuspidata CLARK, Proc. Acad. Nat. Sciences Phila., p. 224, 1876.—MARKTANNER-TURNERETSCHER, Hydroiden von Ost-Spitzbergen, p. 425, 1895.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Juneau, Berg Inlet, and Yakutat, Alaska (Harriman Exped.); Shumagin Islands, Semidi Islands, Unalaska, Port Etches, and Kiska Harbor, Alaska (Clark); British Coast (Alder); New England Coast (A. Agassiz); Greenland (Marktanner-Turneretscher); Puget Sound (Nutting).

SERTULARELLA POLYZONIAS (Linn.).

Sertularia polyzonias LINN., Systema Naturæ, Ed. x, p. 813, 1758.
Sertularella polyzonias GRAY, List of the Specimens of British Animals in the British Museum, part 1, Radiata, London, 1847.—SARS, Bidrag til Kundskaben om Norges Hydroider, p. 44, 1873.—CLARK, Proc. Acad. Nat. Sci. Phila., p. 224, 1876.
Cotulina polyzonias AGASSIZ, Contributions to the Natural History of the United States, Vol. IV, p. 356, 1864.
Sertularella conica CALKINS, Some Hydroids from Puget Sound, Proc. Boston Soc. Nat. Hist., Vol. XXVIII, p. 359, 1899.

Distribution.—Orca, Alaska (Harriman Exped.); Port Etches and Nunivak Island, Alaska (Clark); British Coasts (Gray); North Cape, Norway (Sars); New England Coast (Agassiz); Puget Sound (Calkins).

Calkins, in the reference cited above, identifies a small specimen otherwise identical with *S. polyzonias*, as the species *S. conica* Allman, and says: "The only character, and that a small one, by which to distinguish it from the very wide-spread *S. polyzonias* is the well-marked wrinkling on the adcauline side of the hydrotheca." Specimens from Alaska in the Harriman Collection, agreeing with Calkins's description and figures, have the characteristic gonosome of *S. polyzonias*, and I therefore consider that I am justified in regarding his specimen as belonging to that species.

SERTULARELLA SACCATA sp. nov.

(Plate XXIV, figs. 1-3.)

Sertularella rugosa CLARK, Proc. Acad. Nat. Sci. Phila., p. 224, 1876.

Sertularella geniculata MARKTANNER-TURNERETSCHER, Die Hydroiden Des k. k. naturhistorischen Hofmuseums, p. 222, 1890.

Trophosome.—Colony consisting of a sparingly branched, non-fasciated stem attaining a height of about one inch. Stem annulated and nonhydrothecate proximally, otherwise bearing alternate hydrothecæ, one to each internode; stems and branches erect. Hydrothecæ roughly ovate in general outline, with a laterally inclined, broad, smooth, round neck or collar surmounted by a four-toothed aperture and a four-flapped operculum; below the neck the body of the hydrotheca has three or four broad annular corrugations. Hydranths with about sixteen tentacles.

Gonosome.—Gonangia large, oblong-ovate in general outline, with several, seven to nine, broad annular corrugations. The mature ova are enclosed in an ovoid acrocyst resting on the top of the gonangium.

Distribution.—Popof Island, Alaska (Harriman Exped.); Unalaska, Shumagin Islands, St. Paul Island and Nunivak Island, Alaska (Clark); Jan Mayen (Marktanner-Turneretscher).

The specimens of this species secured by the Harriman Expedition agree well with the figure given by Clark of specimens that he identified as *S. rugosa*. The very conspicuous neck, however, would seem to be sufficient to distinguish *S. saccata* from *S. rugosa*, and the same difference exists between the gonangia of the two forms. The figure given by Marktanner-Turneretscher for *S. geniculata* Hincks differs greatly from Hincks's original description and figure, and agrees well with the present species, except that the hydrothecæ are more closely approximated in the latter.

THUIARIA.

Trophosome.—Colony branched, the branches divided into unequal internodes, each bearing several pairs of opposite or subopposite hydrothecæ. Hydrothecæ usually deeply immersed in the stem or branch to which they are attached. The branches are alternate, and each springs from an unpaired hydrotheca.

Gonosome.—Much as in *Sertularia*.

THUIARIA ARGENTEA (Ellis and Solander).

Sertularia argentea ELLIS and SOLANDER, The Natural History of many curious and uncommon Zoophytes, etc., p. 38, 1786.—CLARK, Hydroids of the Pacific Coast of the United States south of Vancouver Island, Trans. Conn. Acad., Vol. III, p. 251, 1876.—VERRILL, Preliminary Check-list Marine Invertebrates Atlantic Coast, etc., p. 18, 1879.—BERGH, Goplepolyper (Hydroider) fra Kara-Havet, p. 335, 1887.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Yakutat, Alaska (Harriman Exped.) ; British Coast (Ellis and Solander) ; Kara Sea (Bergh) ; New England Coast (Verrill) ; Puget Sound (Nutting) , California (Clark).

THUIARIA SIMILIS (Clark).

Sertularia similis CLARK, Proc. Acad. Nat. Sci. Phila., p. 219, 1876.

Distribution.—Berg Inlet, Glacier Bay, Alaska (Harriman Exped.) ; Hagmeister Island, Alaska (Clark) ; Puget Sound (Nutting, MSS.).

THUIARIA VARIABILIS (Clark).

Sertularia variabilis CLARK, Proc. Acad. Nat. Sci. Phila., p. 221, 1876.

Distribution.—Orca, Alaska (Harriman Exped.) ; numerous stations in Alaska (Clark) ; San Miguel Island, California (Clark) ; Puget Sound (Nutting, MSS.).

THUIARIA CUPRESSOIDES (Clark).

Sertularia cupressoides Clark, Proc. Acad. Nat. Sci. Phila., p. 220, 1876.

Distribution.—Yakutat, Alaska (Harriman Exped.) ; Shumagin Islands and Port Moller, Alaska (Clark).

THUIARIA COEI sp. nov.

(Plate xxvi, figs. 1-3.)

Trophosome.—Colony consisting of a single flexuous stem giving forth regularly alternate branches. Stem three inches high, and divided into irregular internodes each bearing a branch and two hydrothecæ on one side and one hydrotheca on the other. Branches divided into irregular internodes, each usually bearing several pairs of hydrothecæ. Hydrothecæ subopposite, turgid basally, narrowing distally to a horizontal aperture which is pointed on its outer side. An upward projecting point of chitine at the bottom of each hydrotheca.

Gonosome.—Gonangia top-shaped, or obconical, with a pronounced round collar and rather broad aperture. Proximal portion broadly corrugated, and narrowing basally to a short curved pedicel.

Distribution. — Dutch Harbor, Alaska (W. R. Coe, Harriman Exped.).

This is a very distinct species, and the top-shaped gonangia are quite different from any others of the genus that I have seen.

THUIARIA FABRICII (Levinsen).

(Plate xxiv, figs. 4, 5.)

Sertularia fabricii LEVINSEN, Meduser, Ctenophorer og Hydroider fra Grønlands Vestkyst, p. 48, 1893.—CALKINS, Some Hydroids from Alaska and Puget Sound, Proc. Boston Soc. Nat. Hist., Vol. xxviii, p. 361, 1899.

Distribution.—Dutch Harbor, Alaska (Harriman Exped.); Greenland (Levinsen); Puget Sound (Calkins).

A specimen in the Harriman collection agrees perfectly with the descriptions and figures of both Levinsen and Calkins. I have directly compared it with specimens of *Sertularia argentea* from England, and find that the two species are evidently distinct, *T. fabricii* differing from *S. argentea* in the following particulars. The colony is much more bushy in appearance, and more compactly branched. The hydrothecae are more nearly in pairs, and much more closely approximated, are more densely corneous and have a more delicate and less clearly defined aperture. The gonangia are considerably larger and of thinner texture, and are only occasionally armed with lateral spines.

It should be explained that Levinsen regards his *Sertularia fabricii* as identical with the *Sertularia argentea* of authors, and gives it the name *S. fabricii*. My opinion is that the species is distinct, and I recognize the name given by him because he has correctly described and figured the species, although not classing it as distinct. It should, however, be placed in the genus *Thuiaria*, for it comes well within that genus as here defined.

THUIARIA TURGIDA Clark.

(Plate xxv, figs. 4-6.)

Thuiaria turgida CLARK, Proc. Acad. Nat. Sci. Phila., p. 229, 1876.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Sitka, Orca, Popof Island, and Dutch Harbor, Alaska (Harriman Exped.); Port Etches, Shumagin Islands, Semidi Islands, and many other points in Alaska (Clark).

THUIARIA GIGANTEA Clark.

Thuiaria gigantea CLARK, Proc. Acad. Nat. Sci. Phila., p. 230, 1876.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Kadiak and Popof Island, Alaska (Harriman Exped.); St. Paul Island, Hagmeister Island, Unalaska and Kiska Harbor, Alaska (Clark); St. Paul Island (Nutting).

THUIARIA THUIARIOIDES (Clark).

Sertularia thuiarioides CLARK, Proc. Acad. Nat. Sci. Phila., p. 223, 1876.

Distribution.—Yakutat, Alaska (Harriman Exped.); Nunivak Island and Chignik Bay, Alaska (Clark).

THUIARIA ELEGANS sp. nov.

(Plate xxv, figs. 1-3.)

Trophosome.—Colony consisting of a central nonfascicled stem branching in a plumose manner and attaining a height of about six inches. Stem bearing hydrothecæ throughout its length, divided by oblique nodes into long and irregular internodes, each of which usually bears three or four branches; branches alternate, pinnately arranged, unbranched proximally, and distally dividing into a number of branchlets; internodes of stem irregular, but each bearing normally more than one pair of hydrothecæ. Hydrothecæ subalternate, short, pitcher-shaped, with a double curve in front and an even aperture much like the top of a pitcher; operculum composed of a single flap.

Gonosome.—Gonophores borne on the upper sides of the distal ends of the branches in a closely set double row. The individual gonangium is slender, oblong-oval, with a truncated top, an internal distal plug which appears as a dark collar, and an internal mass of developing sex elements.

Distribution.—Berg Inlet, Glacier Bay, 20 fathoms; Dutch Harbor, Alaska (Harriman Exped.).

THUIARIA COSTATA sp. nov.

(Plate xxvi, figs. 4-9.)

Trophosome.—Colony usually a single stem giving forth alternate branches, the whole having a plumose appearance, stem simple, straight, the lower part composed of regular internodes, each bearing a pair of subopposite hydrothecæ, the upper part divided into regular internodes, each bearing a branch and three hydrothecæ; nodes oblique. Branches alternate and themselves branching dichotomously, divided into unequal internodes, each bearing more than two subopposite hydrothecæ. Hydrothecæ turgid below and narrowing above into a short neck which ends in a round aperture facing upward. A chitinous spine projects downward from the lower inner side of each hydrotheca.

Gonosome.—Gonangia borne profusely on both faces of the stem and often on the proximal ends of the branches; oblong-ovate, with a short, small neck and round terminal aperture, the gonangia are ornamented with about five compressed longitudinal ridges, the crests of which are colored black. General color of the gonangia orange brown.

Distribution.—Yakutat, Alaska. Abundant (Harriman Exped.).

This species resembles *Sertularia inconstans* Clark, but differs considerably, particularly in its gonosome, which is very strongly marked.

Family *PLUMULARIDÆ*.

Trophosome.—Hydrothecæ cup-shaped, usually more or less adnate to the stem or branches, and always arranged on one side only of the hydrocladia, or branches, on which they grow. Nematophores present.

Gonosome.—Reproduction by means of planulæ. No medusæ.

PLUMULARIA.

Trophosome.—Hydrocladia unbranched alternate, nematophores on slender pedicels; hydrothecæ without marginal teeth. Stem not canaliculated.

Gonosome.—Gonangia oval, without corbulæ or protective structures of any kind.

PLUMULARIA LAGENIFERA Allman.

Plumularia lagenifera ALLMAN, Jour. Linn. Soc. Zool., XIX, p. 157, 1885.—

NUTTING, American Hydroida, Part I, The Plumularidæ, p. 65, 1900.

Plumularia californica MARKTANNER TURNERETSCHER, Annalen des k. k. Naturhist. Hofmuseums, v, No. 2, p. 255, 1890.—NUTTING, Hydroida from Alaska and Puget Sound, Proc. U. S. Nat. Mus., Vol. XXI, p. 741, 1899.

Distribution.—Berg Inlet, Popof Island, Alaska (Harriman Exped.); Puget Sound (Nutting); Coast of California (Nutting).

PLUMULARIA PALMERI Nutting.

Plumularia palmeri NUTTING, American Hydroida, Part I, The Plumularidæ, p. 65, 1900.

Distribution.—Victoria, B. C. (Harriman Exped.); San Diego, California (Nutting).

This is the only species in the collection that was not from Alaska. It seemed best to include it in the list, particularly as a new locality is thereby noted.

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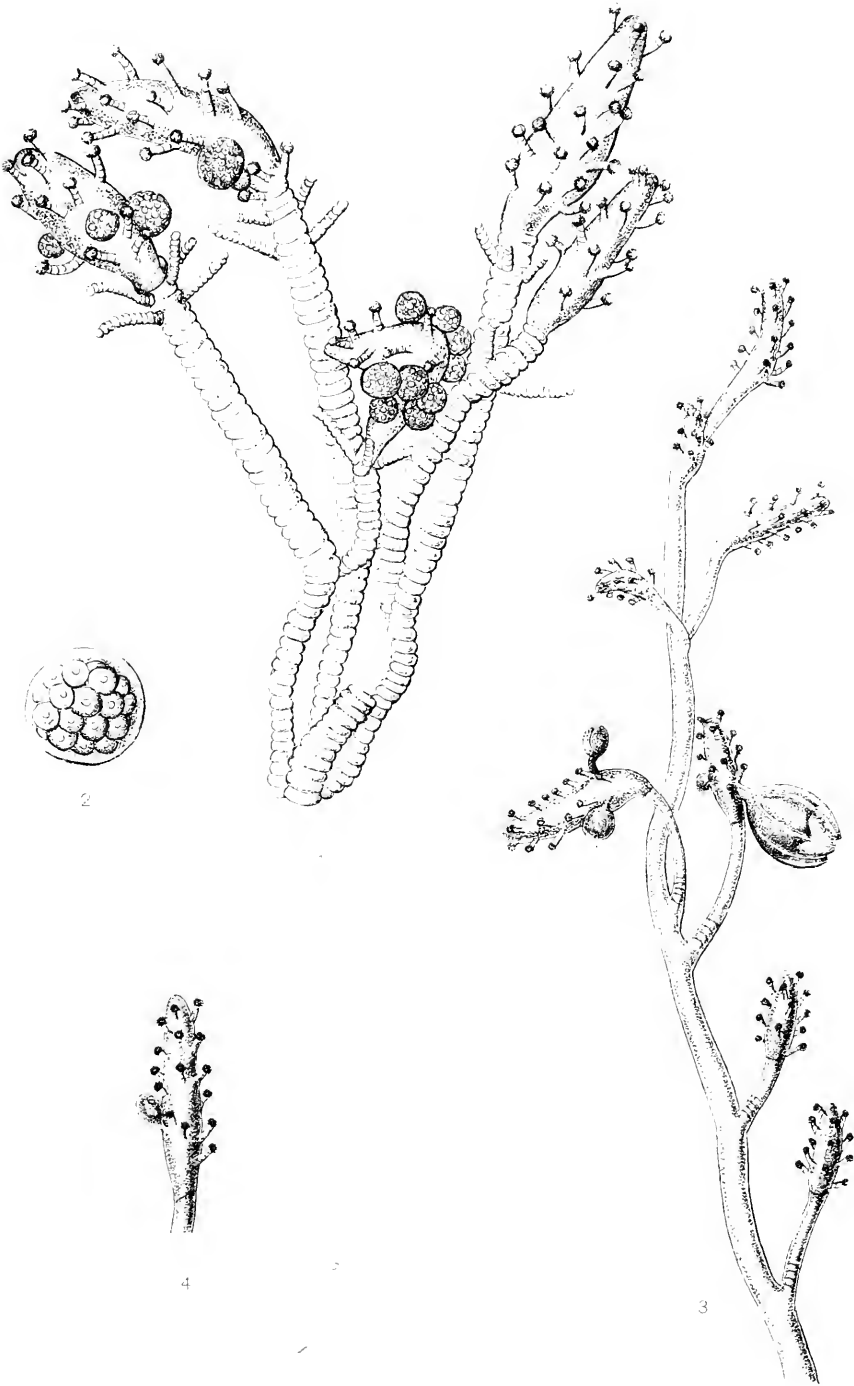
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PLATE XIV.

- FIG. 1. *Coryne brachiata* Nutting. Part of colony.
2. Single gonophore (enlarged).
3. *Syncoryne cximia* Allman. Part of colony.
4. Single hydranth with budding medusa.



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PLATE XV.

- FIG. 1. *Garveia annulata* Nutting. Part of colony, showing hydranths and gonophores.
2. Single hydranth, showing pseudo-hydrotheca (enlarged).
 3. *Eudendrium vaginatum* Allman. Part of colony, showing hydranths and gonophores.
 4. Single hydranth, showing pseudo-hydrotheca (enlarged).
 5. Cluster of female gonophores.
 6. Single gonophore, with expanded chitinous collar (enlarged).

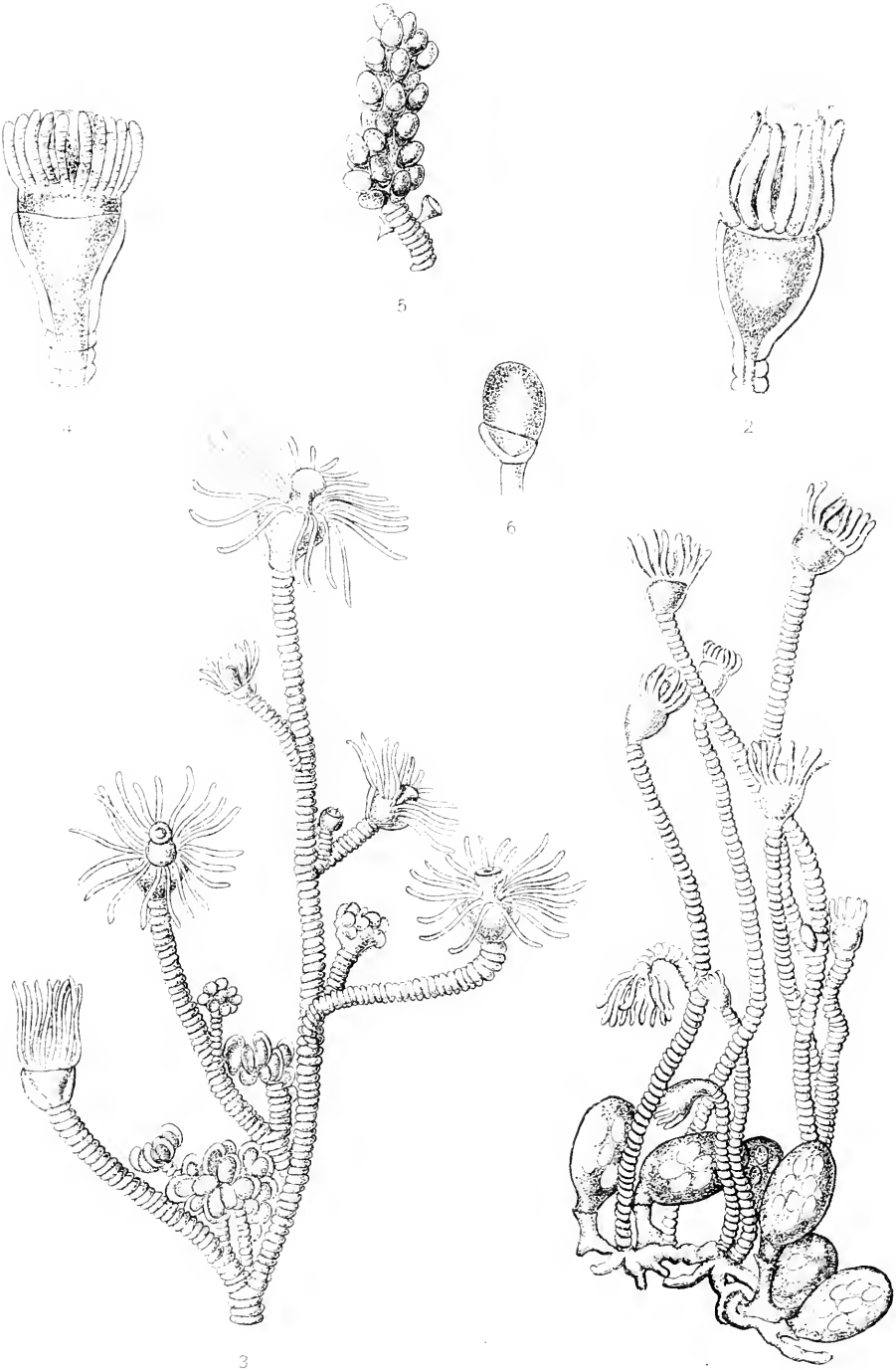


PLATE XVI.

FIG. 1. *Tubularia harrimani* Nutting. Single hydranth with gonophores.

2. Three gonophores, showing apical tentacles and developing actinule (enlarged).

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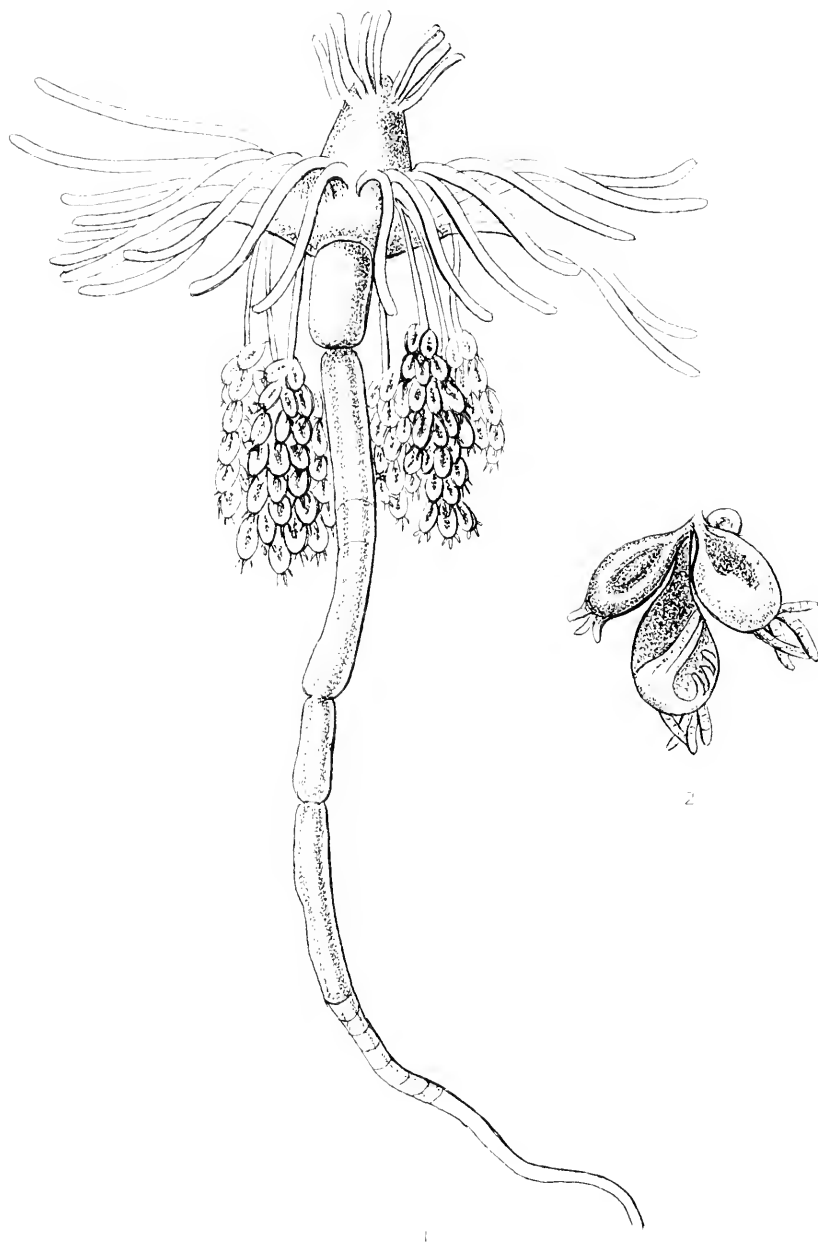


PLATE XVII.

- FIG. 1. *Clytia caliculata* (Hincks). Single hydrotheca (enlarged).
2. Another hydrotheca (enlarged).
3. *Clytia compressa* (Clark). Hydrothecæ (enlarged) showing different degrees of thickening of the hydrothecal walls.
4. Single gonangium (enlarged).
5. *Campanularia ritteri* Nutting. Part of colony (enlarged).

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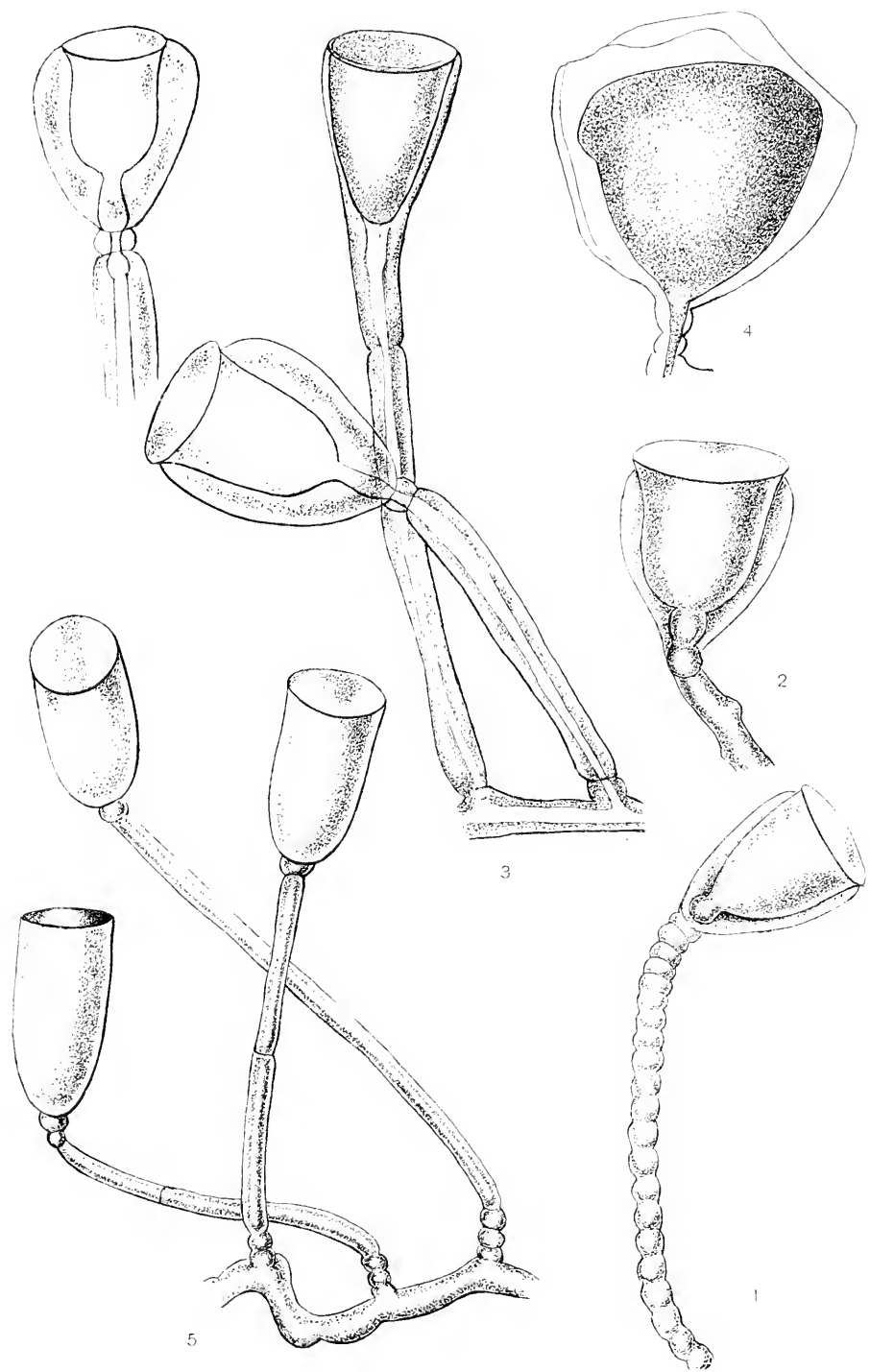
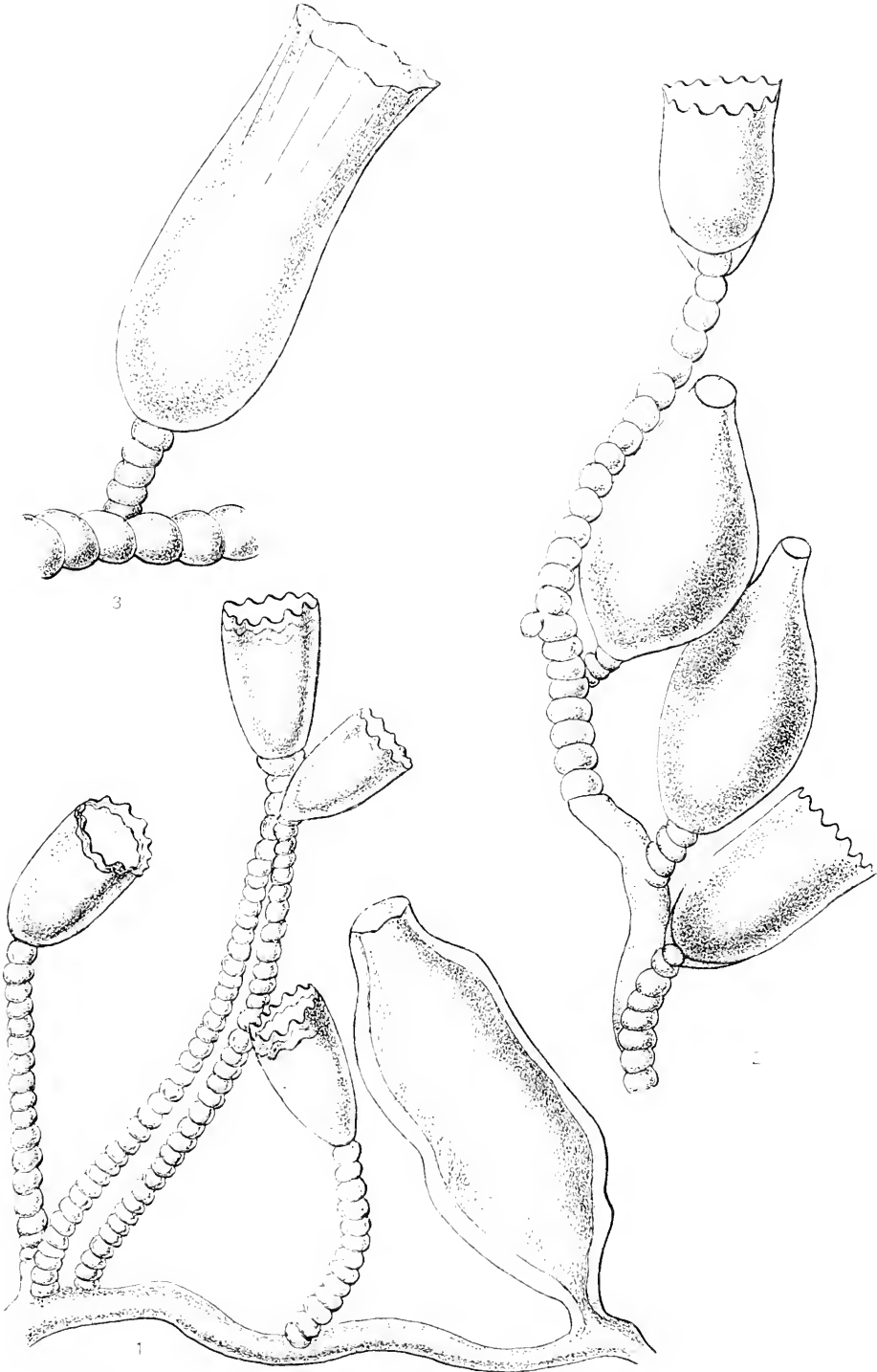


PLATE XVIII.

- FIG. 1.** *Campanularia reduplicata* Nutting. Part of colony, showing hydrothecæ and gonangium (enlarged).
2. *Campanularia urceolata* Clark. Part of colony, showing hydrothecæ and gonangia (enlarged).
3. *Campanularia speciosa* Clark. Single hydrotheca (enlarged).

(200)



ELIZABETH A. P. CRAWFORD DEL.
AFTER C. N.

PLATE XIX.

- FIG. 1. *Campanularia regia* Nutting. Single hydrotheca, showing hydranth (much less enlarged than the other figures).
2. Another hydrotheca, showing reduplication of margin.
3. Hydrotheca of *C. speciosa* Clark (drawn to the same scale as fig. 1, to show comparative size).
4. *Obelia borealis* Nutting. Part of colony, showing hydrothecæ and gonangium (enlarged).
- 5 and 6. Gonangia (greatly enlarged).

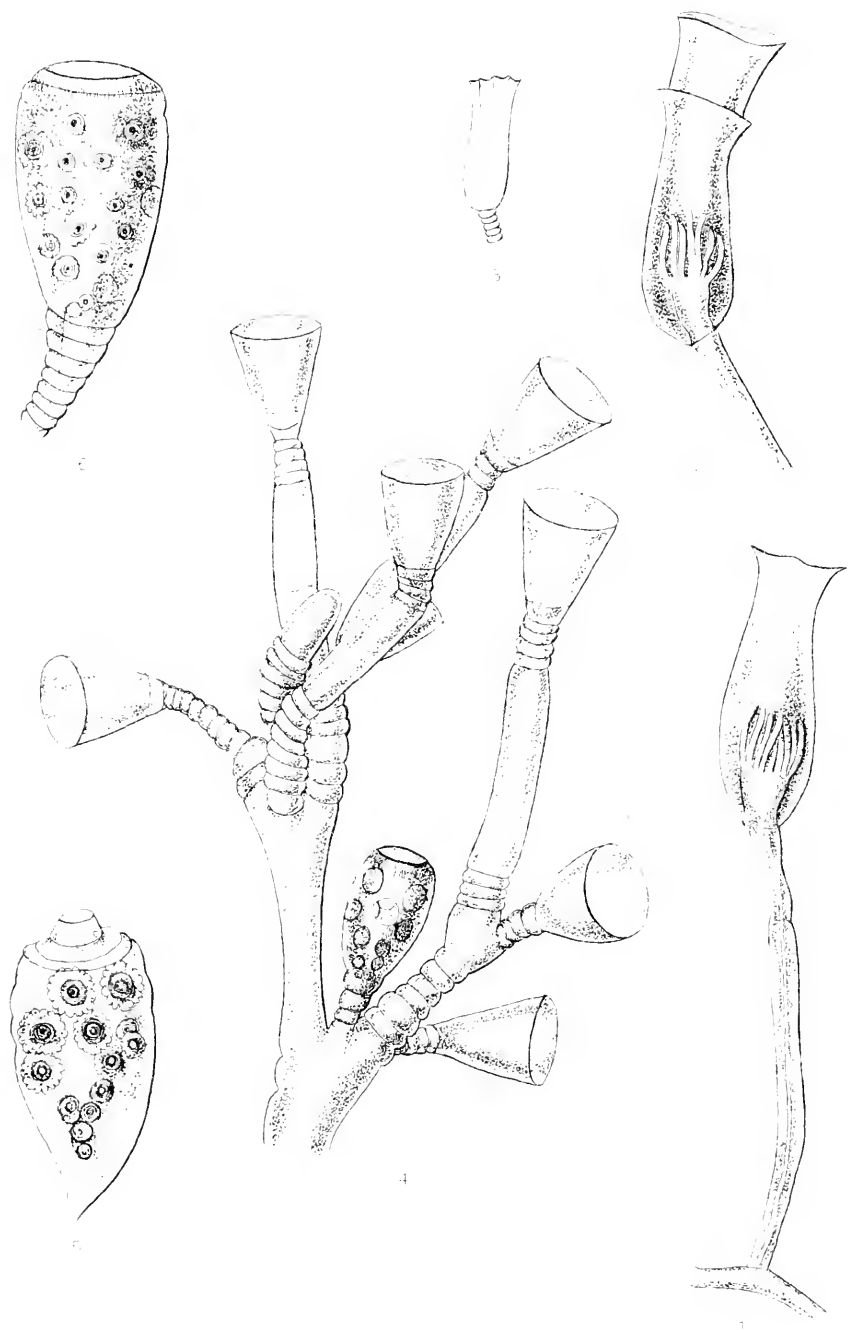
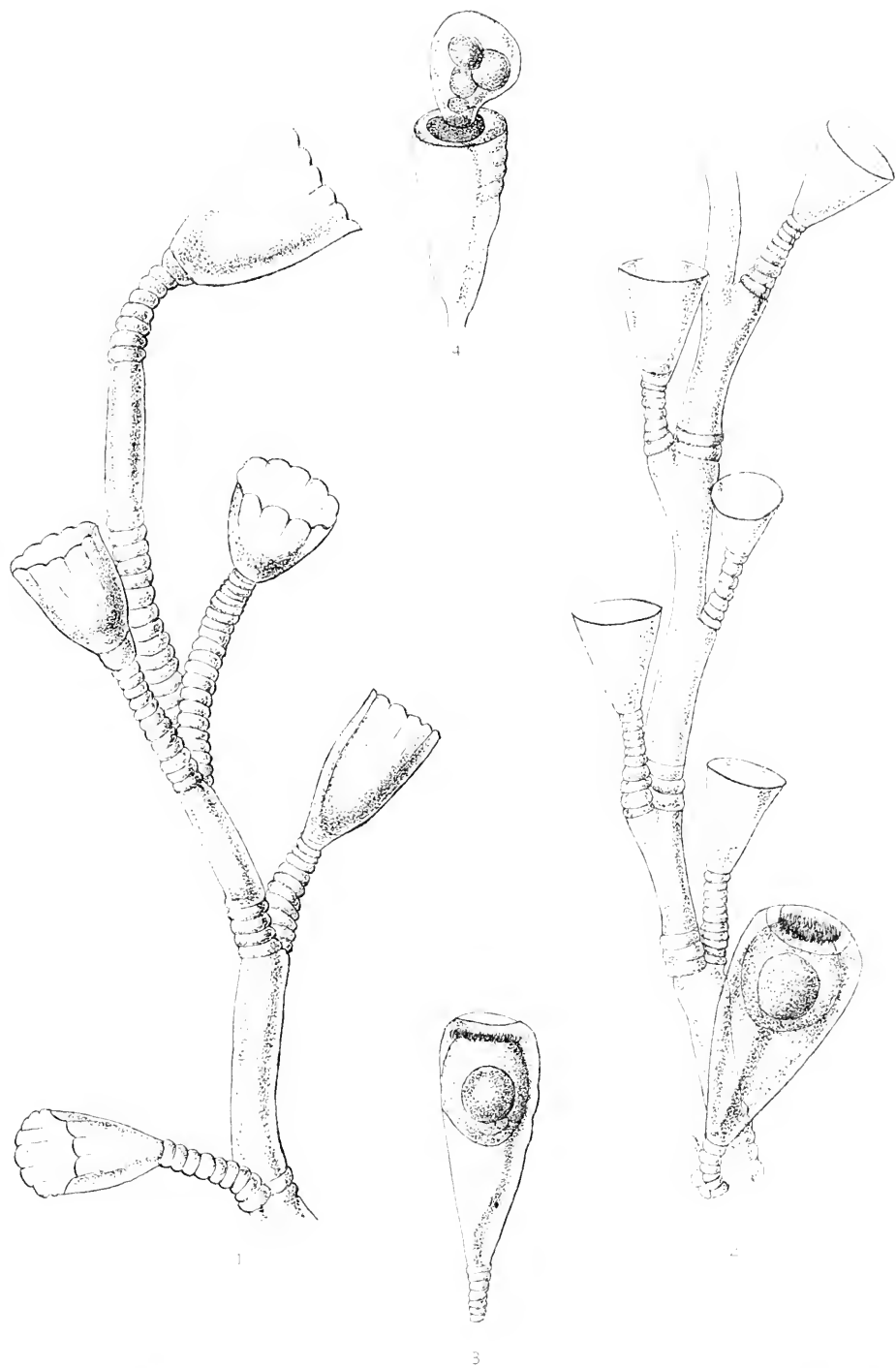


PLATE XX.

FIG. 1. *Obelia dubia* Nutting. Part of colony (enlarged).

2. *Gonothyræa inornata* Nutting. Part of colony, showing hydrothecæ and gonangium (enlarged).

3 and 4. Gonangia (enlarged).



ELIZABETH B. LARSEN, F.S.
AFTER C. H.

PLATE XXI.

- FIG. 1. *Campanulina rugosa* Nutting. Part of colony, showing hydrothecæ and gonangia (enlarged).
2. Gonangium, showing developing medusa (enlarged).
3. *Lafæa adharens* Nutting. Part of trophosome (enlarged).
4. Part of transverse section of gonosome (enlarged).
5. *Grammaria immersa* Nutting. Part of main stem (enlarged).
6. Portion of branch with the peripheral tubes removed to show connection of hydrothecæ with axial tube (more enlarged than fig. 5).

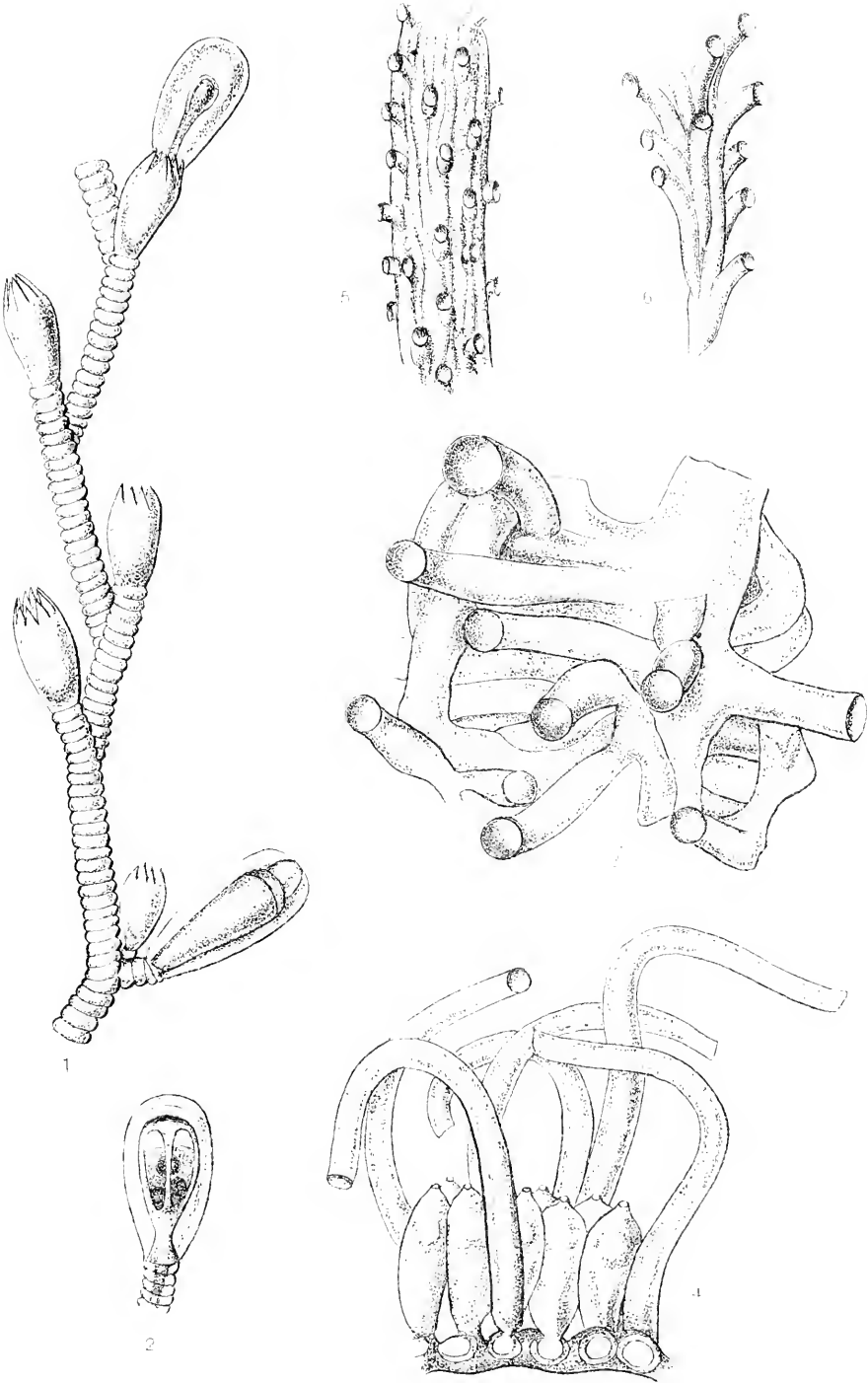
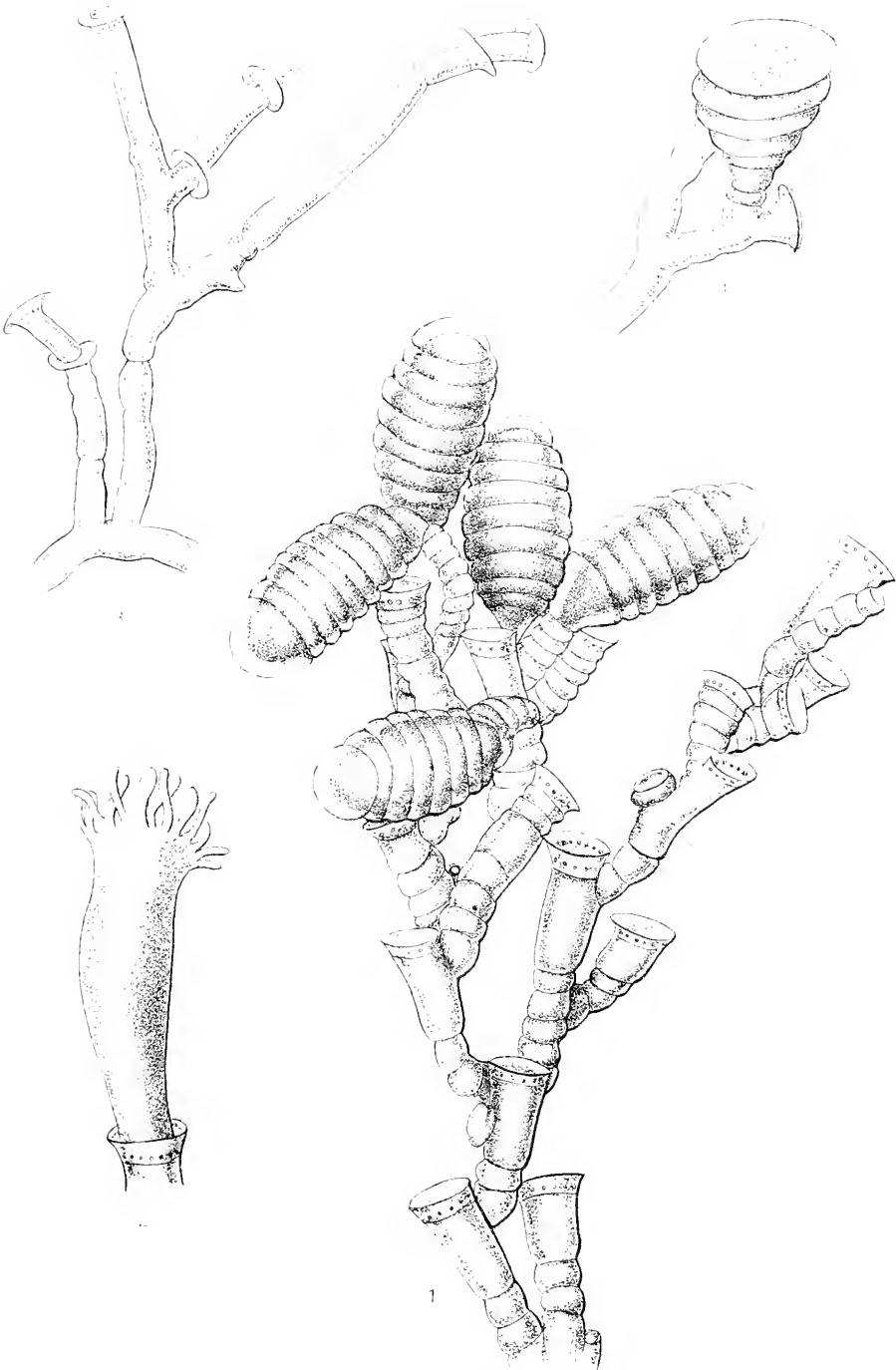


PLATE XXII.

- FIG. 1. *Halccium speciosum* Nutting. Part of colony, showing hydrophores and gonangia (enlarged).
2. Single hydranth (greatly enlarged).
3. *Halecium ornatum* Nutting. Part of colony, showing hydrophores (enlarged).
4. Single immature gonangium (enlarged).



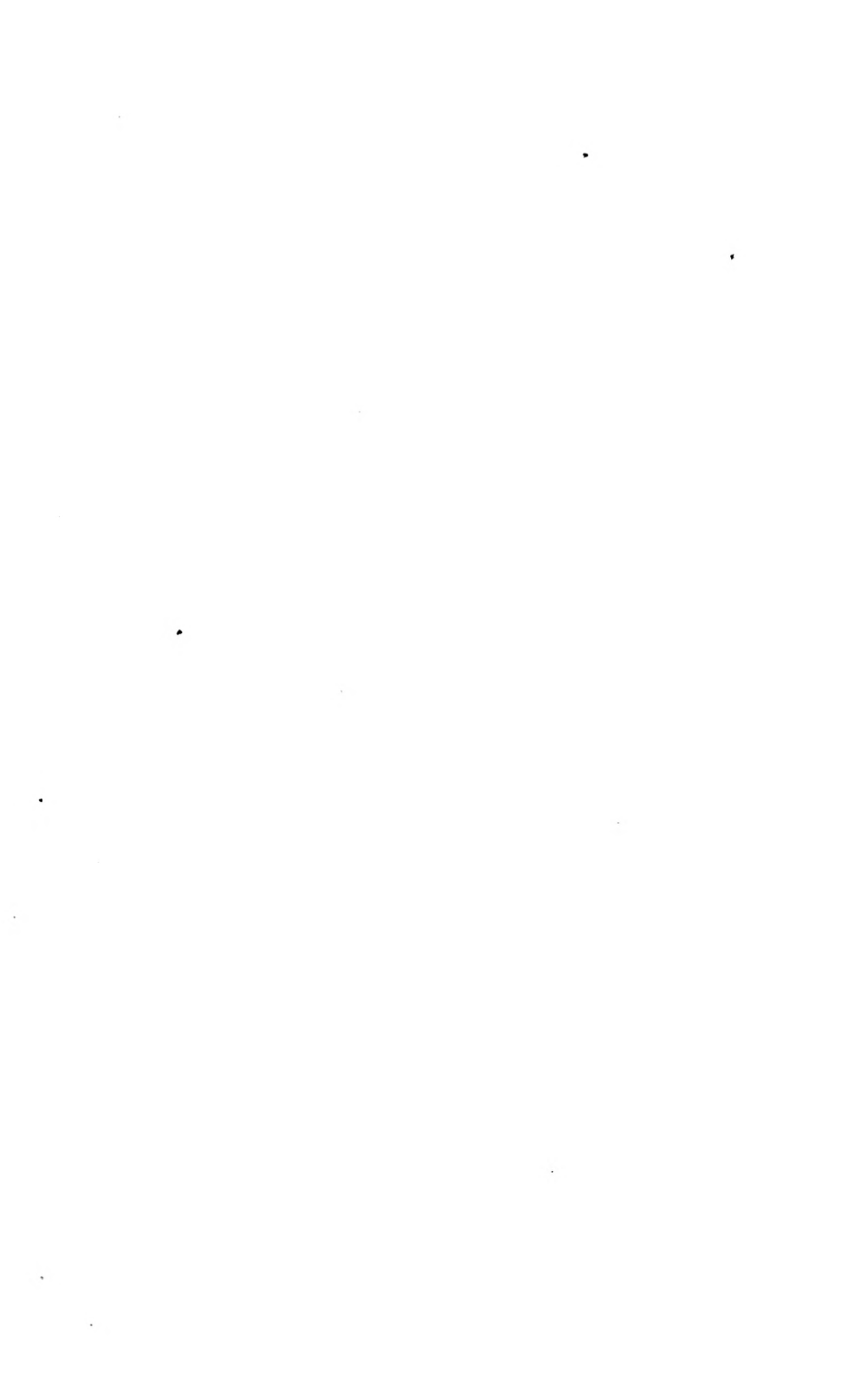
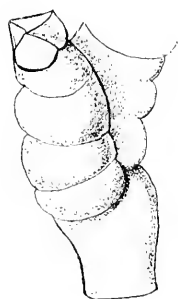


PLATE XXIII.

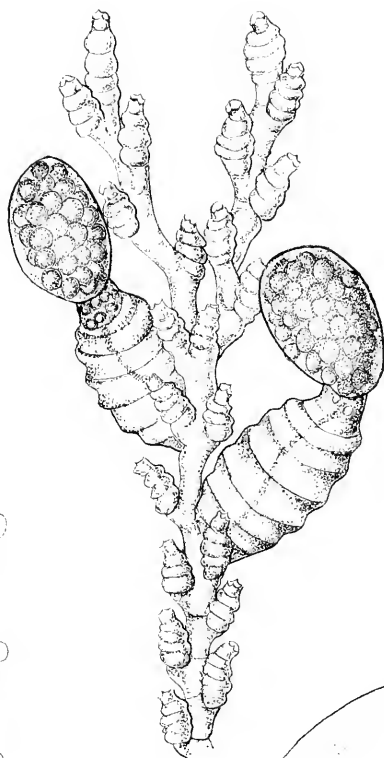
- FIG. 1. *Halecium reversum* Nutting. Part of colony, showing internodes and hydrophores (enlarged).
2. Single hydranth with hydrophore (enlarged).
3. *Halecium robustum* Nutting. Tip of branch, showing expanded hydranths (enlarged).
4. Part of branch with soft parts removed to show the hydrophores (enlarged).
5. Single hydranth with its hydrophore (greatly enlarged).

PLATE XXIV.

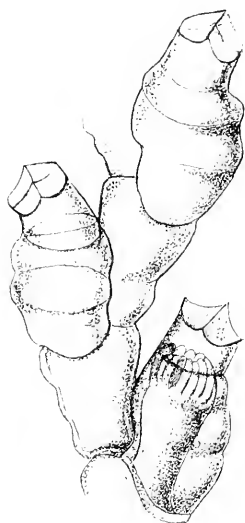
- FIG. 1. *Sertularella saccata* Nutting. Part of colony, showing hydrothecæ and gonangia with acrocysts (enlarged).
2. Three hydrothecæ (still more enlarged).
3. Single hydrotheca, showing operculum (drawn to same scale as Fig. 2).
4. *Thuiaria fabricii* (Levinsen). Part of branch showing hydrothecæ and gonangia (enlarged).
5. Front view of part of branch (enlarged).



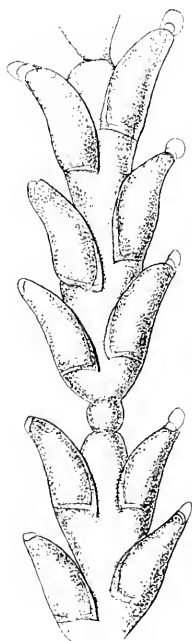
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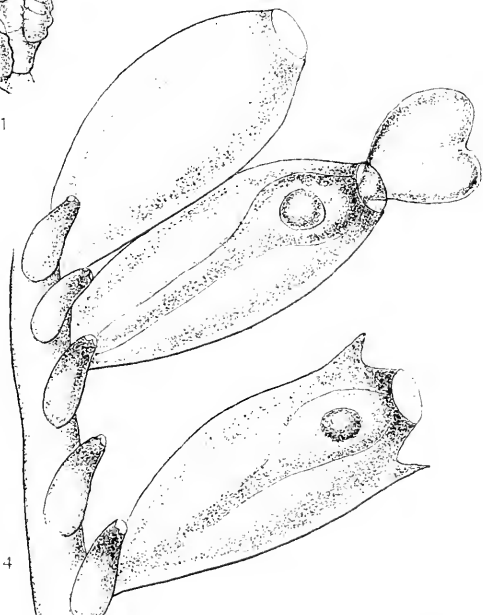
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2



5



4

PLATE XXV.

FIG. 1. *Thuiaria elegans* Nutting.

2. Front view of branch (much enlarged).

3. Gonangium (much enlarged).

4. *Thuiaria turgida* Clark.

5. Two pairs of hydrothecæ (much enlarged).

6. Front view of branch (enlarged).

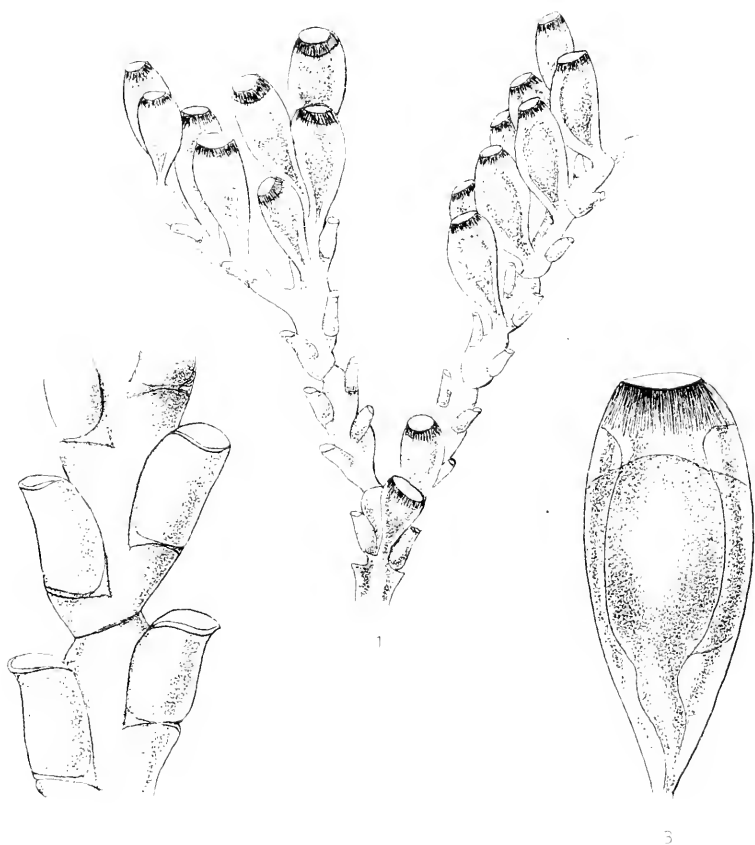
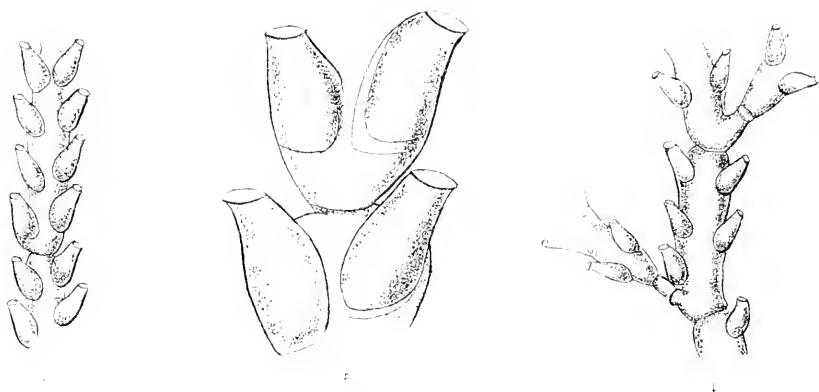


PLATE XXVI.

FIG. 1. *Thuiaria coei* Nutting. Part of branch, showing hydrothecæ and gonangia (enlarged).

2. Lateral view of hydrotheca (enlarged).

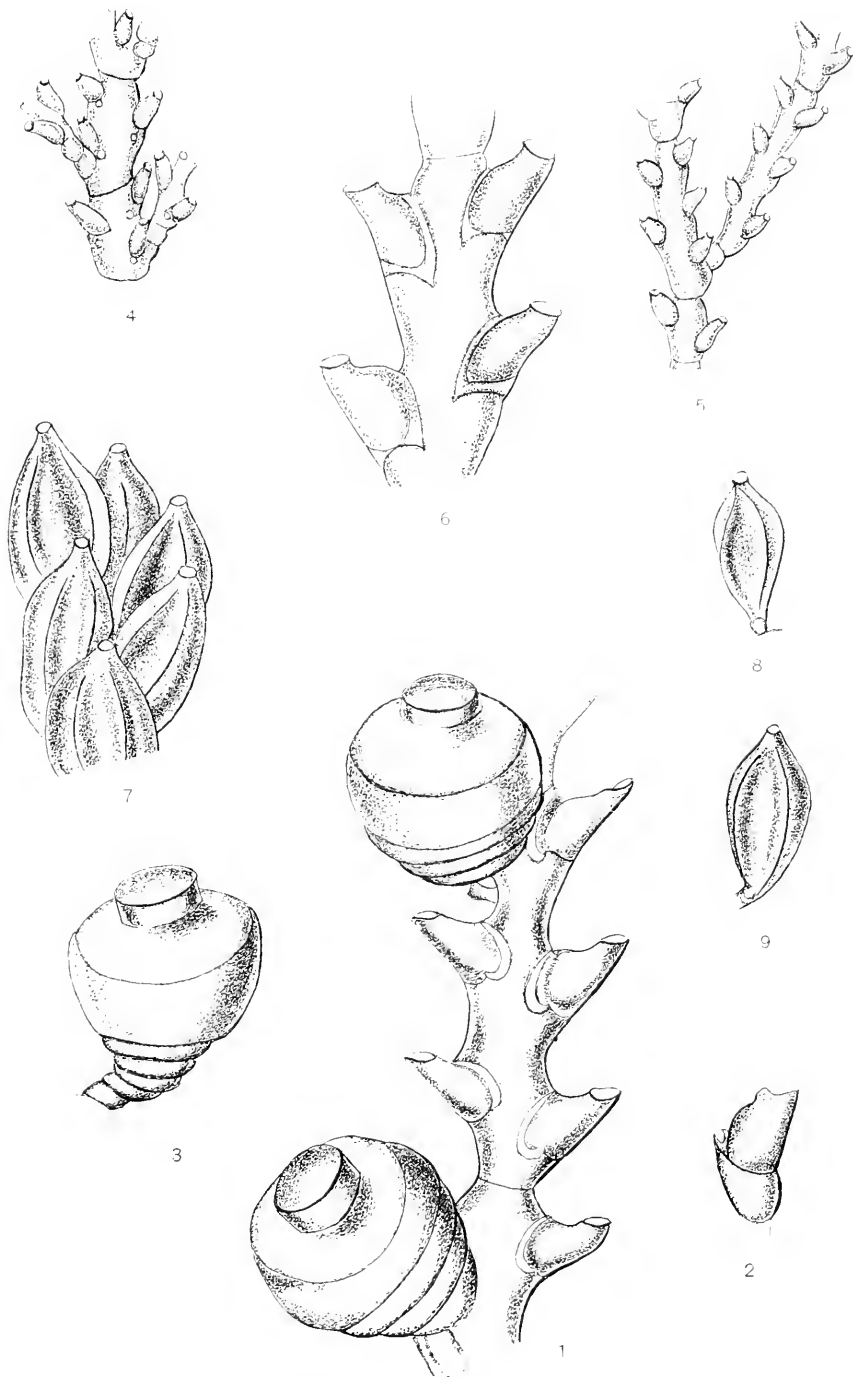
3. Single gonangium (enlarged).

4. *Thuiaria costata* Nutting. Part of main stem, showing origin of branches (enlarged).

5. Front view of terminal branches (enlarged).

6. Two pairs of hydrothecæ (greatly enlarged).

7, 8, 9. Gonangia (enlarged).



PROCEEDINGS
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VOL. III., PP. 217-223.

JULY 13, 1901.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXII.

ENTOMOLOGICAL RESULTS (14):

THE ODONATA.

BY ROLLA P. CURRIE.

THE Odonata collected by Professor Trevor Kincaid during the Harriman Expedition comprise eight species, represented by eighty-nine specimens. None of these appear to be new; yet the collection is interesting in that it serves to extend the known range of certain forms and to add to our knowledge of the Odonata fauna of Alaska.

No paper on the dragonflies of this territory has been hitherto published; and only three species, additional to the eight collected by the Harriman Expedition, have been previously reported from Alaska. These are *Enallagma annexum* (Hagen), *Æschna sitchensis* (Hagen) and *Æschna clepsydra* (Say), thus making eleven species.

Family *AGRIONIDÆ*.

Subfamily *AGRIONINÆ*.

LESTES species (?).

One female belonging to some species of this genus was taken at Fox Point, July 26-28. The species of *Lestes* are separated, mainly, by the characters of the male abdominal appendages, and females taken

singly cannot always be determined with certainty. The following description of the specimen is given for future reference :

Length 34 mm.; abdomen 26; hind wing 20.7; pterostigma 1.7. Blackish-brown. The following parts are pale yellowish, viz : under parts of head, lips, genæ (except a few spots), rhinarium, tips of two basal joints of antennæ, mid-dorsal thoracic carina, humeral stripe (which is wider below), sides of thorax inferiorly (except 2d lateral suture above and some spots near coxæ), and venter of thorax (except middle line which is wider behind). Abdomen yellowish, marked above with dark metallic green as follows : on segment 1, a narrow longitudinal median line, widening behind, and divided into two large divaricate spots; on 2, a mid-dorsal band, divided by a median line which is widened in front, the band widened and orbicular posteriorly (enclosing a pale spot on either side) and connected with the dark apical ring by a short stalk; 3-5 similar, but the dividing line uniformly narrow, the band forming a point anteriorly and barely reaching the base; 6 without posterior pale spots, the bands otherwise as in 3-5; on 7 and 8 the band is wider, not separated, not stalked behind; on 9 and 10 they narrow posteriorly; the bands on 6-10 are blackish-brown, hardly metallic. Sides of abdomen with indistinct dark markings, these principally apical. Venter dark. Tenth segment with its apical margin triangularly notched above, scarcely elevated. Anal appendages two-thirds the length of 10, conical, pale, black on apical half. Genital valves pale, their edges dark apically and minutely denticulate; valvular processes dark, about as long as appendages. Legs pale, the femora without, tibiæ within, and the tarsi, black. Pterostigma brown.

ENALLAGMA CALVERTI Morse.

Enallagma calverti MORSE, Psyche, VII, No. 227, p. 208, March, 1895. (Male described.)—WILLIAMSON, Ent. News, XI, No. 5, p. 455, text fig. 6, Pl. IX, figs. 5, 9 and 10, May, 1900. (Female described and male appendages figured.)

Kukak Bay, June 29-July 5; Cook Inlet, July 21; Kadiak, July 20; Juneau, July 25 : thirty-three males and nineteen females.

These specimens average larger than those I have seen from the United States : Length, ♂ 30.7 mm.-35 mm., ♀ 31.5-35.6; abdomen ♂ 24-27.3, ♀ 24.8-27.3; hind wing ♂ 18.7-21.8, ♀ 20-22.2. In the markings of head, thorax, and abdomen they agree fairly well with *E. cyathigerum* (Charpentier) as described by Selys¹ and exhibit similar variations in the shape and extent of the dorsal abdominal markings, as follows :

¹ Bull. Acad. Belg. (2), XLI, p. 505. 1876.

Males: On segment 1, basal spot usually quadrate, narrowed and more or less rounded on sides behind, its hind margin sometimes excised but usually straight or nearly so and generally with a small median triangular projection; on segment 2, transverse posterior spot: *in front*, convex and more or less rounded, sometimes pointed medially; *behind*, convex, or straight, or sinuated and pointed; sometimes united with apical margin by a short stalk which varies greatly in length, width and shape; sometimes connected with an inferior lateral stripe present in some specimens; on segments 3 to 6, spots more or less pointed anteriorly, widened and usually rounded posteriorly, broadly united with apical ring; spot on segment 3 covering posterior $\frac{1}{3}$ to $\frac{1}{2}$; on 4 covering $\frac{1}{3}$ to $\frac{3}{4}$; on 5, $\frac{2}{5}$ to $\frac{4}{5}$; on 6, $\frac{2}{3}$ to $\frac{5}{6}$. The spot on segment 7 covers apical $\frac{5}{6}$ or more. Dorsum of segment 10 entirely black. Other irregularly placed spots are sometimes present.

Females: Spot on segment 1 similar to that of the males; on 2 quite variable in shape and size, the narrowed portion not always reaching the anterior margin, sometimes bifid; posterior widened portion rounded or angulate laterally; connected directly, or by a short wide stalk, with the apical ring. Spots on segments 3 to 7 similar to those on male but longer, covering apical $\frac{3}{4}$ or more on all of them. Spot on segment 8 exceedingly variable in shape, broadly or narrowly pointed anteriorly, widened behind, connected with posterior margin directly or by a stalk, in one specimen *not* reaching posterior margin; widened portion sometimes connected with a lateral spot or stripe. Spots on segments 9 and 10 covering entire dorsum, narrowing behind.

The postocular spots (in both sexes) are large and in most specimens denticulate behind as in *E. annexum* (Hagen), the denticulations sometimes connected with the blue of rear of head. The male appendages agree well with those of *calverti* as described by Morse and figured by Williamson.

These variations seem to be individual rather than geographical, although the males from Juneau all have very long dorsal spots on the abdominal segments.

This species, described from Nevada, has also been reported from Massachusetts, Maine, Wyoming and Washington.

Family ÆSCHNIDÆ.

Subfamily ÆSCHNINÆ.

ÆSCHNA JUNCEA (Linn.).

Libellula juncea LINN., Syst. Nat., 1, p. 544, n. 10, 1758.

Æschna juncea KIRBY, Synonymic Cat., p. 87, 1890.

One male from Kadiak, July 20; one female, Unga Island, July 17, collected by Prof. W. E. Ritter. The National Museum also contains one male and three females from Nushagak River, Alaska, collected by McKay (No. 97).

This species occurs throughout the northern portions of Europe, Asia, and North America.

The pterostigma is brown, paler in the female specimen.

ÆSCHNA CONSTRICTA (Say).

Æshna constricta SAY, Journ. Ac. Phila., VIII, p. 11, 1839.

Æschna constricta KIRBY, Synonymic Cat., p. 88, 1890.—CALVERT, Trans. Am. Ent. Soc., XX, p. 249, 1893.—KELLICOTT, Bull. Ohio State Univ. (4), No. 5, p. 83, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1889, p. 305, Pl. IV, fig. 10, Pl. VII, figs. 14 & 15, 1900.

Two males, Kadiak, July 20, and Cook Inlet, July 21; two females, Kadiak, July 20.

This is a common species in the United States and has also been recorded from British Columbia, Kamchatka, and Siberia.

The pterostigma in the males is black; in the females yellowish-brown.

Family *LIBELLULIDÆ*.

Subfamily *CORDULINÆ*.

CORDULIA SHURTLEFFI Scudder.

Cordulia shurtleffi SCUDDER, Proc. Bost. Soc. Nat. Hist., x, p. 217, 1866.—SELYS, Bull. Acad. Belg. (2), XXXI, p. 265, 1871.—KIRBY, Synonymic Cat., p. 52, 1890.

One female, Kukak Bay, June 29–July 5; one female, Fox Point, July 26. A female, labeled 'Alaska' and determined as this species, by Dr. P. P. Calvert, is in the collection of the U. S. National Museum; it was received from the U. S. Coast and Geodetic Survey, through Professor T. C. Mendenhall, Superintendent.

This species has also been reported from Nova Scotia, Great Slave Lake (Fort Resolution), New Hampshire, Maine and Pennsylvania.¹

The wings are subfumose in the specimen from Fox Point.

SOMATOCHLORA ALBICINCTA (Burmeister).

Epophthalmia albicincta BURMEISTER, Handb. Ent., II, p. 847, 1839.

Cordulia albicincta HAGEN, Syn. Neur. N. Am., p. 138, 1861.

Cordulia eremita SCUDDER, Proc. Bost. Soc. Nat. Hist., x, p. 215, 1866.—SCUDDER, Proc. Bost. Soc. Nat. Hist., XI, p. 300, 1867.

Epitheca albicincta SELYS, Bull. Acad. Belg. (2), XXXI, p. 303, 1871.

Somatochlora albicincta KIRBY, Synonymic Cat., p. 49, 1890.

¹Ent. News, IX, p. 184, September, 1898.

Eight males and one female, Kadiak, July 20; one female (L. J. Cole, collector), Kadiak, July 4; one male and two females, Kukak Bay, June 29–July 5.

Length, ♂ 47 mm.–49 mm., ♀ 49–50; abdomen with appendages, ♂ 34–36.8, ♀ 35–36.4; hind wing, ♂ 29.4–31.6, ♀ 31–32.2; pterostigma, ♂ ♀ 2.5–3.5; appendages, ♂ 3, ♀ 3.4. The wings in the males are almost clear hyaline; in the females they vary from a clear hyaline to a distinct subfumose. Triangles on anterior wings free or crossed by one nervule; on posterior wings, free (crossed by one nervule in one male and one female); sometimes crossed on right wing, free on left and vice versa. The luteous lateral thoracic spots are sometimes very small or entirely absent.

This species was described from Labrador by Burmeister, while Scudder's *eremita* was from Hermit Lake, in the White Mountains of New Hampshire. Kirby, in his synonymic catalogue, gives it also as occurring in Alaska.

Subfamily **LIBELLULINÆ.**

LEPTETRUM QUADRIMACULATUM (Linn.)

Libellula quadrimaculata LINN., Syst. Nat., I, p. 543, 1758.—CALVERT, Trans. Am. Ent. Soc., XX, p. 258, 1893.—KELLCOTT, Bull. Ohio State Univ. (4), No. 5, p. 100, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, p. 331, 1900.
Leptetrum quadrimaculatum KIRBY, Synonymic Cat., p. 27, 1890.

Two males from Fox Point, July 26–28. This species is found throughout the Northern Hemisphere.

The wings in these two specimens are not clear hyaline, where unmarked, but have a subfumose tinge.

LEUCORHINIA HUDSONICA (Selys).

Libellula hudsonica SELYS, Revue des Odonates ou Libellules d'Europe, Mem. Soc. Roy. Sci. Liège, VI, p. 53, 1850.
Diplax hudsonica HAGEN, Syn. Neur. N. Am., p. 180, 1861.
Leucorhinia hudsonica HAGEN, Proc. Bost. Soc. Nat. Hist., XVIII, p. 78, 1875.—KIRBY, Synonymic Cat., p. 12, 1890.—HAGEN, Trans. Am. Ent. Soc., XVII, p. 233, Pl. X, figs. 13 and 18 *a* & *b*, 1890.
Leucorhinia hageni CALVERT, Trans. Am. Ent. Soc., XVII, p. 36, Pl. V, figs. 2–4, 1890.

Kukak Bay, June 29–July 5, two males; Virgin Bay, Prince William Sound, June 25–26, six males and five females.

These specimens agree very well with Calvert's description (*L. hageni*). The color of thoracic dorsum and sides varies in both sexes from yellow to reddish-brown, this variation being, probably, partly

due to difference in age; the majority of the males are reddish-brown and of the females, yellow. There is considerable variation, also, in the extent of the basal spots of anterior and posterior wings; in two of the females the triangular spot of hind wings extends to the inner angle of the triangle; in two other specimens, also females, the first (anterior) spot of front wings *does not* reach the first antecubital; in the males the first (anterior) spot of hind wings reaches not more than half way to the first antecubital, except in two specimens and in neither of these does it quite reach it. The dorsal abdominal spots are pointed behind, not always reaching the hind margin of the segments. Several specimens have a small basal spot on segment 8. The venation is quite irregular; 6-8 antecubitals in front wings of males (regularly 7), 7 in females; 6-9 postcubitals. On posterior wings, 5-6 antecubitals, 6-10 postcubitals. Two or three rows of discoidal areolet on front wings. Discoidal triangles of both wings free or crossed by one vein. Internal triangles free or composed of two or three cells.

This species has been recorded from Lake Winnipeg, Saskatchewan River and Fort Resolution, British America, from Massachusetts, and from Pictou, Nova Scotia.

The following are notes on four species of dragon flies previously reported from Alaska but of which the Harriman Expedition collected no specimens.

ENALLAGMA ANNEXUM (Hagen).

Agrion annexum HAGEN, Syn. Neur. N. Am., p. 87, 1861.

Enallagma cyathigerum race *annexum* SELYS, Bull. Acad. Belg. (2), xli, p. 506, 1876.—WADSWORTH, Ent. News, III, No. 1, p. 8, January, 1892.

Enallagma annexum WILLIAMSON, Ent. News, xi, No. 5, p. 454, text fig. a, Pl. IX, figs. 3 and 7, May, 1900.

Distribution.—Sitka, Alaska (Hagen); Red River and Saskatchewan, British America; (?) Irkutsk, northern Asia; Vancouver Island; Hermit Lake, White Mountains, New Hampshire; Massachusetts (Selys); Manchester, Maine (Miss Wadsworth); Wyoming, California, and Washington (Williamson).

ÆSCHNA SITCHENSIS Hagen.

Æschna sitchensis HAGEN, Syn. Neur. N. Am., p. 119, 1861.—HAGEN, Proc. Bost. Soc. Nat. Hist., xviii, p. 33, 1875.—KIRBY, Synonymic Cat., p. 87, 1890.—HAGEN, Psyche, v, No. 170, p. 353, June, 1890.

Distribution.—Described from Sitka, Alaska, and afterwards reported from Saskatchewan, British America.

ÆSCHNA CLEPSYDRA (Say).

Æshna clepsydra SAY, Journ. Ac. Phila., VIII, p. 12, 1839.

Æshna clepsydra HAGEN, Syn. Neur. N. Am., p. 122, 1861.—KIRBY, Synonymic Cat., p. 89, 1890.—CALVERT, Trans. Am. Ent. Soc., XX, p. 248, 1893.—KELLICOTT, Bull. Ohio State Univ. (4), No. 5, p. 84, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, p. 305, Pl. VII, figs. 12 and 13, 1900.

Æshna eremita SCUDDER, Proc. Bost. Soc. Nat. Hist., x, p. 213, 1866.

Distribution.—Occurs commonly throughout eastern North America; has also been reported from Dakota and the Saskatchewan in the Great Plains region; and from Irkutsk and the Wilui River, Siberia, and from Finland.

ANAX JUNIUS (Drury).

Libellula junia DRURY, Ill. Nat. Hist., I, pl. 47, fig. 5; App. Vol. II, 1773.
Æshna junia WESTWOOD, Ill., Exot. Ent., by Drury, Westwood's Ed., p. 116, pl. 47, fig. 5, 1837.

Æshna junius SAY, Journ. Acad. Nat. Sci. Phila., VIII, p. 10, 1839.

Æshna junia BURMEISTER, Handb. Ent., II, pt. II, 2d half, p. 841, 1839.—RAMBUR, Hist. Nat. Ins., Neur., p. 196, 1842.

Anax spiniferus RAMBUR, Hist. Nat. Ins., Neur., p. 186, pl. I, fig. 14, 1842.

Anax junia SELYS, Revue des Odonates ou Libellules d'Europe, Mem. Soc. Roy. Sci. Liège, VI, p. 328, 1850.

Anax junius HAGEN, Syn. Neur. N. Am., p. 118, 1861.—HAGEN, Verhandl. Zool.-Bot. Gesells. in Wien, XVII, p. 33, 1867.—BRAUER, Reise der Oesterr. Fregatte Novara um die Erde, Zool. Theil II, I Abth., A, Neuropt., p. 62, 1868.—CALVERT, Trans. Am. Ent. Soc., XX, p. 249, 1893.—KELLICOTT, Bull. Ohio State Univ. (4), No. 5, p. 77, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, p. 306, 1900.—HOLLAND, Ent. News, XI, No. 3, p. 382, March, 1900.

Distribution.—North America, Cuba, Kamchatka, China and Hawaiian Islands. Dr. Holland, in the last citation, records one young male from the mountains between Mission and Fortymile creeks, Alaska, collected July 25, 1899, by Rev. S. Hall Young, and one male from Eagle, Alaska, taken August 3, 1899, by J. Murray Presnall.

PROCEEDINGS
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VOL. III, PP. 225-266.

PLS. XXVII-XXX

JULY 13, 1901.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXIII.

THE ASCIDIANS.

BY WM. E. RITTER.

UNIVERSITY OF CALIFORNIA.

IN view of the wealth of the Ascidian fauna of the Pacific Coast from Puget Sound southward, and of the number of specimens received in chance collections from Alaskan waters, it was something of a surprise that these animals were not found in greater abundance at the points visited by the Harriman Expedition. The most diligent search was made in localities where the conditions appear to be as favorable as at places on the California Coast where they flourish in great luxuriance, both as to number of species and of individuals, and yet only the fifteen species embodied in this report were secured, and the number of individuals of each species was usually small.

The localities at which Ascidians were obtained and the species from each locality are as follows:

Sitka.—*Molgula graphica*; *Psammoplidium pedunculatum*.

Glacier Bay.—*Ascidia adherens*.

Yakutat Bay.—*Ascidia adherens*; *Cynthia villosa*; *Styela yakutatensis*; *S. truncata*; *Distoma pulchra*.

Prince William Sound.—*Rhizomolgula arenaria*; *Amaroucium translucidum*.

Kadiak Island.—*Distaplia occidentalis*; *D. confusa*; *Didemnum strangulatum*; *Amaroucium coei*.

Shumagin Islands.—*Ascidia adhærens*; *Amaroucium californicum*; *Botryllus magnus*.

Seven species were obtained only by dredging; and as the dredge was used but little and not in depths exceeding twenty-five or thirty fathoms, it seems certain that this method of collecting, when more thoroughly applied in these waters, will yield richer returns.

The largest number of species obtained at any one place was five, at Yakutat Bay, where the group seems to be better represented than at any other collecting station. It must be said, however, that the shore collecting was carried on there rather more extensively than elsewhere, and under better conditions, the tides being particularly favorable at the time.

The distribution of marine littoral animals, always a difficult problem, is peculiarly intricate in the case of the Ascidians. The conditions upon which their existence depends appear to be more complex and delicate than for most other groups of animals.

In the course of collecting along the Pacific Coast from southern California to western Alaska during the last ten years, I have been repeatedly surprised at finding Ascidians almost wholly absent from places apparently differing in no respect from others where they occur abundantly. Observations in Alaskan waters have, however, shown that the influence of the glaciers, discharging into the sea, are there an important factor. Few Ascidians were found at any point where considerable glacial débris is present in the water, and where sedimentation is in rapid progress. In all probability the diminished salinity of the water, due to fresh water derived from melting ice, is a condition unfavorable to their existence.

Grateful acknowledgment is here made to two of my associates on the expedition, Dr. Wesley R. Coe and Professor Trevor Kincaid, for their courteous help in collecting Ascidians. Of the fifteen species obtained, eleven are here treated as new to science, one of them being the type of a new genus. The complete list is as follows:

Ascidia adhærens sp. nov.
Molgula graphica sp. nov.
Rhizomolgula arenaria gen. et sp. nov.
Cynthia villosa Stimpson.
Styela yakutatensis sp. nov.
S. truncata sp. nov.
Distoma pulchra sp. nov.
Distaplia confusa sp. nov.
D. occidentalis Ritter.
Didemnum strangulatum sp. nov.
Amaroucium translucidum sp. nov.
A. coei sp. nov.
A. californicum Ritter.
Psammaphidium pedunculatum Herdman.
Botryllus magnus sp. nov.

The material, including slides for microscopic study and dissected preparations, is in the museum of the University of California; but, where the number in the collection would permit, specimens of all the species have been placed in the National Museum at Washington.

ASCIDIA ADHÆRENS sp. nov.

(Pl. xxvii, figs. 1-5.)

General characters.—Attached so closely by the whole left side that the test on this side is much reduced in quantity and the detachment of the animal is made difficult, a peculiarity from which the species is named. Much flattened, elliptical in outline, generally regular, surface for the most part even and smooth. A considerable number of individuals, usually more or less run together edge to edge, the whole forming a thick encrusting layer. Siphons distinct, particularly in larger individuals, though never long. Lobes of siphons inconspicuous, though discernible, when orifices are fully expanded, by small darker specks on the margin. Lobes best seen in smaller individuals. Usually seven on the branchial siphon, and six on the atrial; an occasional individual however, with six and five respectively.

Branchial siphon situated at the anterior end and on the edge; the atrial not remote from the branchial on the right upper surface of the animal, somewhat removed from the edge (pl. xxvii, fig. 2). Color entirely white (opalescent), except a tinge of yellow on the siphons, and some deeper yellow in stomach distinctly visible through test.

MEASUREMENTS OF SOME OF THE LARGER SPECIMENS.

No.	Length.	Width.	Thickness.	Distance Between Siphons.
	mm.	mm.	mm.	mm.
1	28.5	18.5	11	13.5
2	26	19	11	7
3	30	22	16	12
4	27	19	14	8
5	25	16	9	11
6	24	16	9	8
7	19	13	7	8
8	17	12	7	7
9	17	11	5	5

Test of moderate thickness, containing a network of vessels and many large vesicular cells. Mantle nowhere highly developed, but particularly thin on side of attachment where the muscle fibers are almost entirely wanting. Muscle fibers of mantle not disposed in any definite bundles, but spread out in a uniform sheet and running in all directions.

Branchial apparatus.—(Siphons described above.) Branchial tentacles variable in number, even in the same cluster of individuals; thirty-five or more in the larger specimens.

Hypophysis mouth rather large, horseshoe-shaped, about as broad as long, limbs incurved somewhat but not produced into spirals, opening nearly directly forward. Ganglion and gland close together, forming an elongated mass, lying not far behind the hypophysis (pl. xxvii, fig. 4).

Dorsal lamina a rather broad membrane provided with transverse ribs which project somewhat beyond the free edge of the membrane. No serrations of the edge in addition to these projecting ribs (pl. xxvii, fig. 4). Lamina extending for some distance behind the esophageal opening, on the right side.

Folding of the branchial sac not deep, but distinct. Internal longitudinal vessels bearing prominent, though simple, papillæ placed at the points of crossing of the transverse vessels; intermediate papillæ also frequently present, *i. e.*, papillæ in the intervals between the transverse vessels. Usually about two folds of the sac and about ten stigmata between each two longitudinal vessels.

Digestive apparatus.—Mouth of the esophagus far back, though anterior to the posterior end of the dorsal lamina. Stomach rather prominent, cask-shaped, little longer than broad; wall with about six distinct, regular, longitudinal folds on its outer half. Loop of intestine long, reaching more than two-thirds of the way to the anterior end

of the endostyle, with which it is nearly parallel. Anus hardly as far forward as the anterior end of the loop (Pl. XXVII, fig. 3). The clear 'renal vesicles' very abundant along the entire length of the intestine, and extending on the mantle to some extent, but not covering up and obscuring the intestine.

Reproductive organs.—In the intestinal loop, not very voluminous. Vas deferens large and distinct, running along the dorsal side of the rectum.

This *Ascidia* has so many characters in common with *Ascidia koreana* Traustedt that in a former paper (1900) I identified, with considerable hesitation, a few specimens from Puget Sound with Traustedt's species; but now, with ample material at hand, it is clear that the American and Asiatic forms are distinct, though closely related.

Traustedt says of the general form of *A. koreana*: "Corpus ut conus inversus formatum est, infra subacuminatum et supra præcisum."¹ This is so different from that of *A. adherens* and the differences in the intestinal tract and the dorsal lamina are so great that it is impossible to regard them as belonging to the same species. The intestinal loop of *koreana* is neither so long relatively, nor so nearly parallel with the endostylic edge of the sac as that of *adherens*; and apparently since Traustedt makes no mention of the point, the folding of the stomach-wall does not occur in his species. The irregular serration of the edge of the dorsal lamina in *A. koreana* does not occur in the American species, as the description and figure show.

A word should be said with regard to the intermediate papillæ of the branchial sac; *i. e.*, papillæ on the internal longitudinal vessels in the intervals between the crossings of the transverse vessels. These apparently exist, as a rule, but they may or may not be present even in different portions of the same sac. It may be, however, that their presence, as actual intermediate papillæ, is sometimes apparent rather than real, and that when present, this may be due to the suppression of transverse vessels corresponding to them. In regions where they are present (Pl. XXVII, fig. 5) the alternate transverse vessels are much smaller than the others, and one and the same vessel may be interrupted for a considerable distance while the papillæ corresponding to it remain. On the other hand by carefully examining an area in which the intermediate papillæ are present, fragments of vessels corresponding to them are found here and there (Pl. XXVII, fig. 5), so that it may be doubted whether the papillæ are ever present except where transverse vessels actually do cross the longitudinal ones, or where they have existed, or are going to develop.

¹Vidensk. Meddel. fra den naturh. Foren, p. 49, 1884.

Taken in considerable abundance at Popof Island, Shumagin group, July 8, 1899; also in small numbers at Yakutat Bay and Glacier Bay; found on the under side of stones at low tide. Seventy-five or a hundred specimens in the collection. Occurring also in Puget Sound.

MOLGULA GRAPHICA sp. nov.

(Pl. xxvii, figs. 6-9.)

General characters.—Regular in outline, nearly spherical, though somewhat higher than wide and considerably compressed laterally. Attached by small area at posterior end. Siphons not prominent, about 15 mm. apart. Surface of test somewhat uneven, though without pronounced interruptions of any sort, no foreign bodies adhering. Quite transparent, but the numerous, fine, much-branched, almost jet black vessels showing through distinctly in all parts, giving the animal the very characteristic appearance indicated by its specific name (pl. xxvii, fig. 6).

Measurements of the only specimen secured: length 38 mm., width 30 mm., thickness 22 mm.

Test.—Thick and firmly gelatinous. Thickness in middle region of body 6 mm.; somewhat more than this at anterior end, and less posteriorly. The black vessels within it confined mostly to the outermost layers; the test cleaves away from the mantle very easily; its inner surface with a thin stratum, distinctly more opaque. Mantle rather thin, of nearly uniform thickness throughout; musculature of the usual molguloid kind.

Branchial apparatus.—Siphons (with animal removed from test): branchial short and broad with six small almost filiform lobes; atrial two or three times as long, considerably narrower, tapering at the end, with four lobes. Branchial tentacles, about eight, very large, bushy ones, alternating with about as many more of similar size (pl. xxvii, fig. 9).

Dorsal tubercle prominent, hypophysis mouth horseshoe-shaped, opening turned to the right, horns rolled in with about two spirals (pl. xxvii, fig. 8). Endostyle not large; dorsal lamina a plain, rather broad membrane, though with suggestions of a few remote processes on the edge. Branchial sac with seven well-developed and nearly equal folds on each side, from twelve to fourteen longitudinal bars on each fold, no bars between the folds. Transverse vessels very irregular; the largest and most constant of them placed between the deep infundibulæ of the sac which reach into the folds; many finer vessels, ir-

regular in direction and length, between the larger ones, on the surface of the infundibulæ; as a rule, the larger vessels only crossing from one fold to the next.

Stigmata long but irregular, rarely disposed in spiral form, so large and numerous as to leave almost no expanse of branchial membrane unperforated, its whole substance being composed of the narrower bars between them. Considerable dark pigment along the edges of the branchial folds and on the tentacles.

Digestive apparatus.—Situated on left side, esophagus very short, stomach relatively small; intestinal loop narrow and long, extending entirely across the posterior end of the animal: intestine of nearly uniform diameter throughout its length; anus somewhat trumpet-shaped, adherent.

Reproductive organs.—Situated on both sides of the body, ovary on each side a single elongated cylindrical mass extending crosswise of the animal; in the single specimen at hand, testis apparently wanting.

This species is closely related to *M. gregaria* Lesson, but differs from it in possessing the black, much-branched blood vessels in the test, and also in the structure of the branchial sac. Herdman,¹ who has fully redescribed *M. gregaria*, states that the folds are narrow, the internal longitudinal bars few, and that broad horizontal membranes attached to the internal longitudinal bars run along the chief transverse vessels. Moreover, the stigmata are rather small and are arranged in spirals. In all these particulars the two species differ distinctly.

The single specimen was dredged at Sitka in about ten fathoms, on June 15, 1899.

RHIZOMOLGULA gen. nov.

Pedunculate, the peduncle long and slender, bearing many rootlets. Branchial sac with six folds on each side. Gonads on the left side only, situated within the intestinal loop.

RHIZOMOLGULA ARENARIA sp. nov.

(Pl. XXVIII, figs. 10-19².)

General characters.—Peduncle long and slender, giving off many filiform branches, or root hairs, which serve as hold-fasts to anchor the animal to the sand. Body nearly spherical in form, though hav-

¹HERDMAN, Report on the Tunicata of the Challenger Expedition, Part 1, 1882.

ing the antero-posterior diameter somewhat longest. Very regular in outline and unbroken in surface. Test thin, entirely covered by a thin uniform layer of closely adhering sand grains, clinging to the test substance itself and not to processes growing from it (Pl. XXVIII, fig. 10).

Frequently several individuals cling together by their peduncles, but this is apparently due to the tangling of the slender peduncles with one another, and not to actual fusion. Peduncle frequently broken off at or near body.

MEASUREMENTS.

No.	Height.	Greatest Trans. Diam.	Length of Peduncle.
	mm.	mm.	mm.
1	13	21	
2	17	12	15
3	9.5	11	
4	13	20.5	
5	17.5	12.5	16
6	13	12.5	
7	17	13	9

Usually somewhat laterally compressed.

Color uniform gray from the sand covering the surface; test, except for the sand, very transparent. A small area of chocolate color at and around the branchial orifices.

Mantle very thin, separating readily from the test. A large number of small ectodermal processes projecting from its outer surface toward the test, not, however, reaching into the test so far as observed (Pl. XXVIII, figs. 19¹ and 19²).

Musculature not highly developed. Longitudinal muscle fibers grouped into very definite, regularly spaced bundles radiating from the two siphons. Between the siphons a band of closely-placed parallel bundles reaching entirely across from one side of the animal to the other. Circular fibers also disposed in bundles, smaller and less regular, however, than the longitudinal bundles. Circular fibers outside the longitudinal ones; a thin but distinct layer of mesenchymatous tissue between the two.

Branchial apparatus.—Siphons very short and inconspicuous, almost invisible to surface views, situated at the anterior end, nearly as far apart as the width of the animal; branchial with six (occasionally fewer) small lobes; atrial with four lobes. Branchial tentacles twelve to fourteen in number, branched, but not deeply or profusely.

Hypophysis mouth horseshoe-shaped, broader than long, opening forward, somewhat to the left, horns not coiled (Pl. XXVIII, fig. 19).

Ganglion very close to the hypophysis opening. Branchial sac with six well developed, nearly equal folds on each side; six or seven longitudinal vessels on each fold; none between the folds. No transverse vessels present besides the imperfect septa between the infundibulæ. Infundibulæ deep and rather narrow, the stigmata reaching entirely around them; quite regular in size and arrangement (pl. XXVIII, fig. 18). Endostyle narrow. Dorsal lamina a plain broad membrane terminating at the left of the esophageal opening.

Digestive apparatus.—Esophageal opening at the extreme postero-dorsal angle of the branchial sac. Intestinal loop reaching entirely across the animal; rather broad at its ventral end, but closed together dorsally where the rectal bend comes in contact with the esophagus. Dorsal limb of rectum rather short, running close along the dorsal edge of the animal.

Esophagus narrow, stomach nearly cylindrical, somewhat longer than thick, set off from the esophagus by an abrupt shoulder, its wall thrown into about ten or twelve distinct, closely approximated, somewhat tortuous, longitudinal ridges, of a light yellow color. Intestine from stomach to anus of nearly equal diameter throughout. Anus unarmed (pl. XXVIII, fig. 11).

Reproductive organs.—Present on left side only, and both ovary and testis placed within the intestinal loop, which they completely fill. Ovary occupying the middle; testis in the form of a great number of nearly spherical masses surrounding the ovary and in close contact with the intestine. Oviduct very short, running along the dorsal side of the rectum (pl. XXVIII, fig. 11).

Renal organs.—Consisting of two small, somewhat elongated, but irregular bodies situated one on each side of the body far back and clinging to the inner surface of the mantle.

I have not observed the ectodermal processes or papillæ on the outer surface of the mantle (pl. XXVIII, figs. 19¹ and 19²) in any other Ascidian, nor have I found anything like them described in any other species, though they are undoubtedly homologous with the ectodermal portion of the processes occurring on many species of *Molgula*.

They are scattered over the entire surface of the mantle, but are somewhat more abundant at the posterior end. Each one consists of a wall of distinct epithelial cells, and a lumen which communicates freely with the body space, and into which the blood passes. The ends are somewhat bulbous owing to the larger size of their epithelial cells.

The peduncle, with its system of rootlets and holdfasts, is a remarkable
Proc. Wash. Acad. Sci., July, 1901.

able structure. Its resemblance to the branching 'tap-root' of some plants is striking enough. The peduncle proper is usually as long as the body of the animal or longer. It is always thread-like, or lash-like. At its junction with the body it is considerably larger in diameter than it is elsewhere, but it diminishes abruptly to the small size which it holds for most of its length.

The root-hairs are not scattered uniformly throughout the length of the peduncle, but are in the main grouped in tufts with a few single ones given off here and there. Sand grains cling tenaciously to the hair tufts and increase the resemblance to a plant root (pl. xxviii, figs. 10 and 13).

The minute structure of the peduncle and rootlets is peculiar, and quite unexpected in view of the structure of similar growths in other Ascidians. The smallest of the root-hairs, examined with a high power, have a striking resemblance to a medullated nerve fiber. Each contains a central fiber, homogeneous in appearance and of regular outline that would correspond to the axis cylinder; and a transparent, structureless outer portion forming the greater bulk of the whole, that would correspond to the medullary substance (pl. xxviii, fig. 15). Each of these rootlets, if traced distally, is found to terminate in a more or less bulbous enlargement, the main structural element of which is the thickened and closely tortuous end of the central fiber. The outer transparent substance of the bulb does not differ essentially, either in structure or relative amount, from that of the intermediate portions of the rootlet. In some instances the bulbs are merely slight enlargements of the rootlet, the length being considerably greater than the thickness. In others again they are thicker than long and are set off from the rootlet by a pronounced shoulder. In these latter cases the central fiber is often converted into a considerable mass by being itself somewhat enlarged, and by being thrown into close windings.

By tracing the rootlets, proximally to their origins in other secondary roots (pl. xxviii, fig. 15) or in the main stem (pl. xxviii, fig. 14) one finds that the central fibers enter the main stem, either directly or by continuing to it through a larger rootlet, and then run on, preserving their individuality, up through the stem to the body of the animal (pl. xxviii, fig. 14). Thus it follows that the peduncle, at its junction with the body, contains a very large number of these fibers—as many as the entire number of rootlets.

The nature of the axial fibers is not obvious at first sight. Attentive examination, however, proves them to be muscle fibers. The chief difficulty in the way of immediately recognizing their true nature

is the fact that in many places they are contracted into a more or less regular spiral, the coils of which are so close that, seen as they always are through the material in which they are imbedded, they appear to be made up of discrete bodies which may easily be mistaken for cells. By staining them in various ways and clearing them in glycerine and clove oil, and, especially, by following the individual fibers far enough (for often they may be traced all the way into the body of the animal) their real character can be determined beyond question. One point concerning them, however, I have not been able to make out with certainty. In the terminal bulbs are frequently seen what appear to be definite loops formed by the central fibers, and in places between the bulb and the point of branching the fiber sometimes appears to be double. Both these facts suggest the possibility and support the belief that each fiber is double; that is, extends down the rootlet to the end and there turns back upon itself. These fibers are, without much doubt, fibers from the mantle that have grown into the peduncle first of all, and then out into the rootlets; and it would seem probable that in this process they have looped in rather than grown in at a free end. One may imagine that the thing was accomplished by a process similar to the looping-out of the mantle fibers on the atrial languet in some species of *Amaroucium* or *Distaplia* for example, or over the incubatory pouch of *Colella*. The evidence for this interpretation, however, is not conclusive. In many places in the rootlets the fibers are certainly not double when fully mature; whether the two strands may have become fused into one here, or one of them become wholly degenerated, I am unable to say.

The most puzzling thing in the structure of the rootlets is the fact that the muscle fibers are actually *embedded in the test, and are not situated in a cavity with an epithelial wall derived from the ectoderm of the mantle*. From all analogies one would expect the rootlets to be in reality ectodermal vessels, each with a thin layer of test. I have, however, searched in vain for epithelial cells of any sort either in the rootlets or the larger portions of the peduncle. Even after staining with hæmatoxylin, which can always be relied on to bring out the nuclei in epithelial tissues of the Ascidians, not even a suggestion of nuclei has appeared in these structures. All the outside transparent material is apparently test and nothing else. Moreover, by splitting the peduncle at its larger, proximal end next to the body in the plane of the fiber bundles, one obtains conclusive evidence that the muscle fibers are fully surrounded by the test material. In such a place as that shown in Pl. XXVIII, fig. 16, for example, one or two fibers are

separated out distinctly from the main bundle, and the test matter with its scattered test cells can be clearly seen, fully enveloping the fibers. It can be confidently asserted that, in most cases, no lumen is present in the ultimate rootlets in which blood may flow.¹

In all probability these are all developed at first as ectodermal vessels, and the ectodermal layer and lumen of the vessel become secondarily obliterated. It is difficult to see by what other method the conditions could be reached. The only direct confirmatory evidence that I have been able to get, however, is the fact that in one rather small specimen from which most of the peduncle was wanting, because of having been broken off, as I at first supposed, the rather short remaining piece was found to contain an outpocketing of the ectoderm of the mantle, with the epithelial layer showing very distinctly. No muscle fibers were present, however, in this instance, and this fact together with the failure to find, on closer examination, evidence that the peduncle had been broken, leads me to believe that this was an incipient peduncle into which the muscle fibers had not yet penetrated, and from which the ectodermal layer had not begun to degenerate. Before leaving this subject, so well deserving further study on young animals, I would draw particular attention to the *apparent* gradual transition of the test cells themselves, into the muscle fibers, as shown in Pl. XXVIII, fig. 17. This figure is drawn from a peduncle near the body and might be duplicated from any specimen. It is, of course, impossible to affirm that there has been a production of muscles fibers from test cells, as the adult structure here suggests. In view, however, of the fact that the test cells are now known to be of mesenchymatous origin it is not difficult to suppose that the development has taken place as the structure actually found indicates. Muscle fibers might very well be formed, probably are formed, from mesenchyme cells in the vessels while these still exist. But the mesenchyme cells migrate through the ectoderm to become test cells. With the disappearance of the ectoderm, then, mesenchyme and test would be in direct contact, and what would be essentially a transition from test cells to muscle cells would then be possible.

¹ On consulting the classical work of Lacaze-Duthier, 1874, on the *Molgulidæ*, I find the following concerning the villousities of the test. One may make out the nuclei of the walls of the canals, the author says, "mais on ne distingue jamais aussi bien qu'après avoir employé les imbibitions ou les autres manipulations histologiques, ces cellules régulièrement polyédriques." It is possible therefore that further study of the root hairs of *Rhizomolgula* on fresh and specially prepared material will bring out the epithelium, but from my experience it seems hardly probable.

The already rather large number of genera of the *Molgulidæ*, several of which are not very clearly defined and contain only a few species, has made me very reluctant to add another one-species genus. From this course, however, there seems to be no escape. Of the previously established genera, *Eugyriopsis*, proposed by Roule in 1885, and modified by Pizon in 1898, would receive this Alaskan species with less forcing, perhaps, than would any other genus. This group, regarded by Roule as a subgenus of *Molgula*, was established for species with a single sexual gland situated on the left side of the body, *outside and in front of the intestinal loop*. The last part of the definition, it will be observed, would stand in the way of the admission of the species under discussion. But Pizon has very recently (1898) concluded, after a consideration of the classification of the *Molgulidæ* based upon the examination of a considerable number of genera and species, that *Eugyriopsis* should be regarded as a genus including all species with gonads on the left side only; and with curved stigmata, more or less regular, and more or less elongated, but not arranged in the great infundibulæ characteristic of *Eugyra*. The situation of the gonads within or without the intestinal loop, he considers a matter not of generic importance, and in this view I am disposed to coincide. The gonads are so inconstant in this family, particularly as to position, that the small difference here considered, at any rate when taken by itself, seems insufficient to establish generic rank. If, however, it is linked with the other characters, in which *R. arenaria* differs from *Eugyriopsis*, viz.; first, the possession of a peduncle, and second, the presence of six folds in the branchial sac instead of seven, the coupling of the two in the same genus is made obviously impossible.

Another genus which has considerable claim on our species is *Bostriobranchus* Traustedt. Here the single gonad is situated on the left side of the body and within the intestinal loop; but the absence of the peduncle and of true folds in the branchial sac, decides against the admission of *R. arenaria* to this genus.

The only pedunculated genus of the family is *Ascopera* Herdman, 1882; but the peduncle here is an entirely different thing from that of *Rhizomolgula* being nothing more than a somewhat produced posterior end of the body. Furthermore, the infundibulæ in the branchial sac are lacking, and the gonads are present on both sides of the body, so that *Rhizomolgula* is far removed from this genus.

The collection contains about thirty specimens all from Orca, Prince William Sound, where they were taken on fishing lines by Dr. Coe and Mr. Cole, on June 28, 1899, in about twenty fathoms.

CYNTHIA VILLOSA Stimp.

Cynthia villosa STIMPSON, Proc. Acad. Nat. Sci., Phila., Vol. 16, p. 160, 1864.—HERDMAN, Trans. Liverpool Biol. Soc., Vol. XII, p. 258, figs. 7-11, pl. XII, 1898.

Herdman has recently described in detail this species, which Stimpson characterized by its external features only. The only serious difficulty in identifying the Alaskan specimens now under consideration, with the Puget Sound forms is in the number of folds of the branchial sac. According to Herdman, the latter possess eight on each side, and his statement is confirmed by the examination of some large specimens from Puget Sound, undoubtedly belonging to the same species, and which were sent me by the Young Naturalists' Club of Seattle. The Alaskan specimens, on the other hand, possess only six, with rudiments of a seventh. These individuals are all small however, the largest being only 12 mm. high by 12 mm. deep, and 8 mm. thick; and one specimen of about the same size among those from Puget Sound has, so far as I am able to determine, only six on each side. I deem it probable therefore that this difference in the number of folds is due to difference in age. There is some difference in the spines also, these in the Alaska specimens being somewhat shorter, and more inclined to an arrangement in groups on papillæ of the test. As a rule, however, they are neither in groups nor on papillæ; so this difference is not constant. Herdman has fully discussed the relationships between the echinated species of the genus that were known at the time of his writing. Since then, however, Hartmeyer, 1899, has described a new species, *C. arctica*, to which he refers a form of *C. echinata* from Kara Sea, described by Traustedt. In the two particulars in which the Alaskan specimens differ from the typical *villosa* they incline toward *C. arctica*, for in this species the spines are situated in groups of eight or ten on prominent papillæ of the test, and the folds of the sac are seven, or occasionally eight, in number.

In the number of tentacles, however, the Alaskan form of *villosa* agrees with the type and not with *arctica*; and since, as shown above, neither of its *arctica* tendencies is pronounced, it must be considered most closely allied to *villosa*. Perhaps further study of more material will show the necessity of establishing a new species for it; but as the matter now stands this course is not justifiable.

There are about fifteen specimens in the collection, all from Yakutat Bay, taken on rocks at extreme low tide, June 20-22, 1899.

STYELA YAKUTATENSIS sp. nov.

(Pl. xxvii, figs. 20 and 21.)

General characters.—A pedunculate species with the following measurements :

No.	Length.			Depth, greatest.	Thickness, greatest.
	Total.	Of body.	Of pedunc.		
	mm.	mm.	mm.	mm.	mm.
1	57	38	20	15	12
2	40	24	15	10	8
3	38	25	13	11	8
4	40	28	14	11	9
5	31	21	11	9	7
6	22	14	8	7	5
7	38	22	17	10	7
8	30	20	11	7	5
9	28	18	11	6	6
10	30	18	12	9	8
11	20	13	7	8	7
12	15	11	5	5	4
13	21	15	10	6	6
14	21	12	8	7	6
15	22	14	9	5	4
16	22	15	7	7	6
17	29	20	9	10	9
18	37	26	11	10	10
19	19	12	7	8	7
20	22	14	8	8	7
21	14	10	4	5	4
22	14	9	4	7	5.5
Mean	27.7	18.1	10.1	8.2	6.8

These averages give :

Length of body = 1.8 × length of peduncle.

Depth of body = 1.2 × thickness of body.

Outlines are shown in pl. xxvii, figs. 20 and 21.

Transition from body to peduncle usually, though not always, rather abrupt. Surface but little corrugated or roughened, usually free from foreign bodies. Siphons rather small and short, the branchial directed forward, the atrial turned ventralward.

General color light with a distinct tinge of yellow ; the siphons and a small area around them deep salmon, the color, however, entirely disappearing in alcoholic specimens.

Test rather more delicate and transparent than usual for species of this genus, the intestine showing through it even in nearly full grown specimens.

Branchial apparatus.—Form and proportions of siphons described

above. Both obscurely four-lobed, the lobes in preserved specimens often imperceptible. Branchial tentacles, in the largest specimens at hand, not much exceeding forty and not differing greatly in size.

In a specimen 15 mm. in total length (one of the smallest at hand) the tentacles are as follows: Twelve of good size and nearly equal, twelve considerably smaller, alternating with these, and, alternating with these twenty-four, the merest buds of as many more. From a comparison of this condition with that found in the largest individuals it appears that, typically, new tentacles are added, first twelve and next twenty-four, until the individual is well grown, and that then the smaller, later tentacles continue to grow until all of the circle are in old specimens, practically, of the same size. Dorsal tubercle prominent.

Branchial sac with four folds on each side. Formula of internal longitudinal vessels as follows :

Endostyle.	First.		Second.		Third.		Fourth.		Fifth.	Dorsal Lamina.
Length of specimen.	space.	fold.	space.	fold.	space.	fold.	space.	fold.	space.	(Count just behind tentacles.)
55 mm.	3	5	4	10	4	6	5	14	3	
57 "		5	6	6	5	10	7	14	3	
?	3	4	5	8	5	9	4	14	5	

The frequent uncertainty as to whether vessels at the bases of the folds should be counted as belonging to fold or space, and the frequent change in direction of the vessels with reference to the folds at different levels of the same sac, render it impossible to rely on this character, except within rather wide limits. This remark applies especially to small folds.

Endostyle narrow and tortuous. Dorsal lamina a narrow, plain membrane.

Digestive tract.—Of the typical *Styela* type; folds of the stomach wall crowded, about thirty in number; anus encircled by a fringe of from ten to twenty blunt, irregular processes.

Gonads.—Ovaries two cylindrical bodies on each side of the sac, the ventral one on the left side suppressed in the region of the stomach. Testis in the usual form of scattered nodules along the ovaries. Both ova and sperm nearly, if not quite, ripe.

This species is allied to *S. montereyensis* Dall, and *S. greeleyi* Ritter, but the material now available for study furnishes no transitional forms toward either. The most distinctive character is the proportionate length of peduncle and body. In this respect the three species

form a series, *S. greeleyi* having the longest peduncle; *S. montereyensis* the next and *S. yakutatensis* the shortest. *S. yakutatensis* differs from *S. montereyensis*, also in possessing a maximum of less than fifty tentacles; whereas *montereyensis* reaches as high as one hundred. The difference between *yakutatensis* and *montereyensis* in the structure of the sac cannot be regarded as of specific importance.

In large specimens of *greeleyi* the first and fourth folds of the sac possess a considerably greater number of bars than they ever appear to have in *yakutatensis*. Furthermore, the bilobed condition of the anus in *greeleyi* does not occur in *yakutatensis*.

Further study of specimens from localities between those from which these three species come, may be expected to throw light on the relations of this interesting series. The collection contains about seventy specimens of all sizes, all taken from a reef near Khantaak Island, Yakutat Bay, at extreme low tide, on June 21, 1899.

STYELA TRUNCATA sp. nov.

(Pl. XXVII, figs. 22 and 23.)

General characters.—Irregularly cone-shaped, attached by the base, which is cleanly truncated by the surface which serves to attach it; the base distinctly broader than any other transverse section of the body. Several of the largest individuals inclined somewhat to one side.

MEASUREMENTS.¹

Specimens.	Height.	Diameter of base.	
		Greatest.	Least.
	mm.	mm.	mm.
Largest	20	17	13
Intermediate.....	18	13	10
One of the smaller.....	8	10	8

Siphons small and near together; in larger specimens almost entirely hidden by the large irregular tubercles of the test which beset a small area of the anterior end. The remaining portions of the body nearly even and smooth, though in some specimens more or less covered with an encrusting bryozoan. Color of whole anterior end a reddish brown, siphons not differing from surrounding portions. Test rather thin, but firm; mantle thin, the musculature being rather feebly developed.

¹ The measurements of the smallest one in the table are exceptional; in general, the proportions of the small specimens more nearly agree with the largest one in the table.

Branchial apparatus.—Siphons short and small, in larger individuals almost entirely hidden by the tuberculation of the test, obscurely four-lobed. Branchial tentacles about twenty, subequal in length.

Hypophysis mouth horseshoe-shaped, horns not rolled; opening to the left and toward the branchial siphon. Branchial sac with four folds on each side, all of about equal prominence excepting No. 4, which is somewhat larger. Formula for internal longitudinal vessels:

Endostyle.	First.		Second.		Third.		Fourth.		Fifth.
Length of specimen.	space.	fold.	space	fold.	space.	fold.	space.	fold.	space.
18 mm.	1	6	1	8	1	6	1	10	1
?	1	8	1	8	1	8	1	11	1

Transverse vessels of three sizes. From five to seven stigmata to the mesh. Endostyle narrow; dorsal lamina a plain, low membrane.

Digestive apparatus.—Stomach long and narrow, about twice as long as thick; somewhat curved, the concave side looking upward; having about fifteen longitudinal folds in its wall. Anus surrounded by a circle of about ten or twelve short thick knobs; the terminal portion of the rectum in the specimens examined narrowed down to a thin neck.

Gonads.—Two ovaries on each side, each a long, simple, tortuous, cylindrical mass. Testis pouches scattered along these in the usual way. Both sets of glands nearly or quite ripe, but no tadpoles seen.

Externally this species is very similar to *S. joannæ* Herdman, from Puget Sound (Herdman, 1899), but differs from it in having only two in place of seven or eight ovaries on each side, and also in having only one, in place of four, internal longitudinal vessels between the folds of the branchial sac. Also it rather closely resembles *S. pæssleri* Michaelson¹ from the region of Cape Horn from which it differs, however, in possessing fewer branchial tentacles, *pæssleri* having sixty, and in the prominence of some of the folds of the branchial sac; in *pæssleri* the first, or both first and second, are more or less rudimentary.

Found on rocks at extreme low tide, Khantaak Island, Yakutat Bay, June 21, 1899. There are about fifty specimens of different sizes in the collection.

¹ Zool. Anzeiger, No. 560, 1898.

DISTOMA PULCHRA sp. nov.

(Pl. xxx, figs, 24 and 25.)

General character of the colony.—Composed of sheaf-like bunches united by their basal ends only, each bunch containing from ten to twenty large and long zooids, some of which are free at the anterior end for rather more than the length of the thorax, the remainder being embedded in the common test, which is present, however, in small quantity between the bodies of the zooids. Height of the bunches about 20 to 25 mm.; thickness at the upper end, *i. e.*, in the portion containing the thoraces, about 12 mm.; in the next thicker portion, *i. e.*, that containing the abdomens, about 10 mm.; of the constricted portion immediately behind the thoraces, about 6 mm. Bunches quite regular both in form and size, having much the appearance of sheaves of 'club' wheat, the thoraces corresponding to the heads of the wheat, the constricted portion to the position of the band of the sheaf, and the enlarged abdominal region to the butt of the sheaf.

Color.—Anterior end transparent, wholly without pigment; posterior end pinkish yellow from the great amount of food matter contained in the abdomens of the zooids, which show distinctly through the thin layer of colorless test.

Test.—Small in quantity, indeed in the posterior half of the bunches, scarcely visible at first sight; somewhat more abundant anteriorly, especially where a few thoraces are united. Examination of ample material might reveal some evidence that closely adhering, flattened, stolon-like masses of test are present. Ordinary test cells very abundant, but no bladder cells, spicules, or nodules present.

Zooids.—Maximum number in a bunch about twenty. Very closely packed in the bunches, particularly at their posterior ends; anterior ends more or less free, most of them for only a small portion of the thorax, but a few for considerably more than the thorax. Frequently a small number—two or three—in a bunch united to nearly the end, and together free from the rest of the bunch for a part or all of the extent of the thorax.

Entire length of body distinctly visible through the test. Thorax not withdrawn from the test in preservation. Thorax and posterior end of abdomen strikingly thicker than middle portion of body. Total length 20 to 25 mm., equaling height of the bunches. Thorax about 7 mm.; narrow neck-like portion of body, about 8 mm.; thick portion of abdomen about 10 mm., maximum thickness of thorax, including test, about 4 mm.; of abdomen about 3.5 mm.

Mantle.—Very thin throughout; circular muscle fibers absent except in a narrow, weak sphincter for each siphon. Eight or ten weak longitudinal muscle bands on each side, running obliquely across the thorax, antero-ventrally to postero-dorsally; anastomosing sparingly anteriorly, and becoming spread out into a thin layer apparently increasing somewhat in number posteriorly, in the abdominal region.

Branchial apparatus.—Siphons long and prominent, both deeply and regularly six-lobed, the lobes expanded. Tentacles about twelve, all nearly equal in length and rather long; placed in a close cluster near the siphonal opening. Peripharyngeal field broad (pl. xxx, fig. 25).

Eight series of stigmata, about thirty-five in each half-series; stigmata exceedingly regular in form, rather long and narrow. Internal membranes, on the circular vessels, broad. Dorsal languets about as long as branchial tentacles, broad at base, shading off into the internal membranes of the branchial sac to which they correspond in number. Endostyle rather narrow. Postero-ventral corner of the sac produced backward, the esophagus issuing from the postero-dorsal angle. The whole branchial apparatus quite transparent, and usually very little contracted in preservation.

Digestive tract.—Esophagus long and narrow, the length more than twice that of the branchial sac. Stomach long and narrow, about 4 mm. long, by 1.5 mm. broad; cylindrical, the wall with about six regular, longitudinal folds. Loop of the intestine extending but a short distance behind the stomach; very narrow. Rectal portion of intestine soon joining the esophagus and running close along with it through the narrow portion of the body. Whole posterior end of intestinal loop so embedded in the food material of this part of the abdomen as to make study of it difficult.

Reproductive organs.—Situated in the intestinal loop; ovary composed of numerous cylindrical, often anastomosing, branches. No specimens in reproductive activity at hand.

The question of the affinities of this striking species is very puzzling. For a time I was much inclined to consider it a *Stereoclavella* rather closely related to *S. australis* Herdman, the general character of the colony and especially the freedom of many of the thoraces apparently justifying this view; and, although I now regard it as more closely allied to *Distoma* than to any other genus, its kinship with *Stereoclavella* is undoubted. The combination of Distomid and Clavelinid characters in this species furnishes additional evidence, of which so much has been forthcoming during recent years, of the close relationship between the Distomidæ and the Clavelinidæ.

The two considerations of most weight in assigning the species to *Distoma* are, first, the deep and broad siphonal lobes, and, second, the fact that while many of the thoraces in the colony are distinct most of them are not at all free. Further study of more material, particularly of young colonies and the process of budding, may reverse my conclusion on this point; for a few young blastozoids are present on the specimens at hand, and these are at least as much isolated as the full grown ones. Moreover, the large quantity of mesenchymatous food material stored in the abdomen is probably rather more Distomid than Clavelinid.

Within the genus *Distoma* the general character of the colony resembles considerably that of *D. laysani*, recently described by Sluiter,¹ from Laysan, South Pacific. The resemblance goes no farther, however, for the zooids are very different in the two, *D. laysani* being much smaller, having a very inconspicuous, smooth-walled stomach and only three rows of stigmata. On the whole *D. pulchra* is probably more closely related to *D. adriaticum* v. Drasche than to any other known species, though the two really have very little in common. The colonies, though pedunculated in both, are very different. *Adriaticum* has fifty branchial tentacles and twenty-four series of stigmata.

According to Lahille *D. cristallium* Renier is the only other species known in which the stomach wall possesses parallel folds. This, however, is not a pedunculated form.

Found at Yakutat Bay, on rocks at extreme low tide, June 20, 1899. One large and one small cluster of bunches in the collection.

DISTAPLIA OCCIDENTALIS Ritter.

Distaplia occidentalis BANCROFT, Bull. Mus. Comp. Zool., Vol. xxxv, No. 4, p. 59, 1899.—RITTER, Annals N. Y. Acad. Sci., Vol. xii, No. 14, p. 609, 1900.

Although the identification of the specimens at hand with this wide-ranging Pacific Coast *Distaplia*, is doubtful for several reasons yet the species is so exceedingly variable and the quantity of material of the Alaska form now available for examination so small that I do not feel justified in regarding the differences as of more than individual value.

The two most important differences that I note are the denser, more muscular thorax of the northern specimens and the greater distinctness of the folds of the stomach wall.

A single small colony was dredged in Kadiak harbor, July 3, 1899.

¹ Zool. Jahrb., Bd. xiii, 1890.

DISTAPLIA CONFUSA sp. nov.

(Pl. xxix, figs. 26 and 27.)

General characters of the colony.—Thin and encrusting, about 3 or 4 mm. thick, and quite uniform; largest piece at hand 40 mm. in length by about the same width. Irregular in outline, very soft. Of a dark, purplish ashen color, due to pigment in the test. Test in large quantity as compared with the number of zooids. A few branched vessels, some bearing ampullæ within the test.

Zooids.—Few in number, scattered in the most irregular way, and occupying the most varied positions as regards direction of axes relative to surface of colony. Apparently no systems present. Of a nearly uniform sooty color, but little darker, however, than the test, and, therefore, showing indistinctly through it.

Many abdomens without thoraces present; of the characteristic distomid dumbbell shape, the handle long, straight and slender, the outline of the ends irregular, owing to prominent interruptions caused by the few voluminous ova projecting from the posterior end of the abdomen.

Length about 7 mm. (greater than thickness of the colony, this being possible from the extremely oblique position of the zooids). Thickness of thorax about 1.5 mm., abdomen about the same.

Mantle.—Extremely delicate; circular muscle fibers apparently wholly absent; longitudinal few, very fine, and but imperfectly grouped in bundles.

Branchial apparatus.—No visible orifices on the surface of the colony; branchial siphon very broad and short, wide open in correlation with the absence of sphincter muscle fibers; lobes wide, low, and irregular. Atrial orifice large, no siphon, but a wide and, in some zooids, rather long languet.

Four series of long, narrow stigmata with about sixteen stigmata in each half-series. Tentacles and dorsal languets not seen owing to the contracted state of the sac.

Posterior ventral corner of sac not extended back behind esophageal opening, but esophagus issuing from middle of posterior end of sac (pl. xxix, fig. 26).

Digestive tract.—Nearly straight, loop narrow, post-gastric intestine returning abruptly back upon the esophagus and meeting it at the entrance of the latter into the stomach; from here the straight rectal portion closely applied to the esophagus, and accompanying it forward to the thorax. The general form of the tract thus made to resemble closely

the distomid type. Narrow esophageal-rectal portion about equalling thorax in length. Stomach of moderate size, somewhat shorter than branchial sac; longer than broad, the longer axis forming an angle of about 45 degrees with main axis of animal; external surface of wall smooth, but inner surface marked by a close, rather regular reticulation showing through, due to low narrow folds in the wall. Reticulation more pronounced in fully grown zooids (Pl. XXIX, figs. 26 and 27).

Reproductive organs.—Ovary situated in part on the right side of the intestinal loop but chiefly behind it. Ova few but very large. Testis not seen. No embryos in the specimens at hand, consequently presence or absence of brood pouch not determined, facts probably indicative of immaturity of specimens. The presence of well-developed ectodermal appendages of the mantle in most of the zooids indicative of same conclusion, according to the statement of Bancroft,¹ that in *D. magnilarva* and *D. occidentalis* these structures are found only in the young.

The close general resemblance of the zooids of *D. confusa* to the typical *Distoma* zooid is striking indeed. So far as I am aware, no other *Distaplia* possesses the long straight esophagus found here.

For a time I was much disposed to identify the species with *D. livida* Huitfeldt-Kaas (Sars), of the Norwegian coast, and there can be no doubt about the close relationship of the two forms. It is quite possible that further study of more specimens from both Alaska and Norway, will prove them to be the same. At present, it seems clear that the shortness of the zooids of *D. livida* (4 mm. according to Huitfeldt-Kaas) indicates that the peculiar, long, straight esophageal-rectal stretch of the intestine is not present in that species. Furthermore, Huitfeldt-Kaas² speaks of the colonies of *D. livida* as being "composed of very soft, thick, irregular, lobed lamellæ with a maximum area of 2.5 cm. and a thickness of about 7 mm.

Dredged in about twenty fathoms, Kadiak harbor, July 3, 1899. Encrusting on lamellibranch shells. Two colonies in the collection.

DIDEMNUM STRANGULATUM sp. nov.

(Pl. XXIX, fig. 28.)

General characters of the colony.—Flat, incrusting, thin. Largest colony in the collection 4 mm. long by 2 mm. broad; 5 mm. thick in thickest part, 1 mm. in thinnest part. Color ashen, zooids showing distinctly through the test. Apparently no systems present; zooids distributed very uniformly, rather numerous.

¹ Bull. Mus. Comp. Zool., xxxv, No. 4, 1899.

² Norw. N. Atl. Exped., 1876-1879, Zool., Christiania, 1896.

Test.—Containing many cells of various kinds, but no bladder cells. The granular bodies (cells?) numerous. Calcareous stellate bodies present, though not abundant; not found at all in some colonies. Rays short and blunt.

Zooids.—Small, about 2 mm. long; uniformly distributed. Division of body into thorax and abdomen distinct; abdomen considerably larger than thorax, and broader than long. The narrow peduncle connecting thorax and abdomen always (in specimens at hand) with a deep, narrow constriction at which severance occurs with great ease. Many abdomens free in the test from normal rupture at this point (pl. xxix, fig. 28). Mantle sending off one or more clavate ectodermal appendages from the middle region of the body. Longitudinal muscle fibers moderately developed; a few circular ones also present even in middle portion of thorax.

Branchial apparatus.—Branchial siphon of moderate length; six-lobed, the lobes usually distinct though never prominent, sometimes nearly absent. Atrial siphon shorter, though present; placed far back, and inclined somewhat backward; lobes as prominent as those of branchial siphon. Branchial sac so much contracted as to make determination of internal structure difficult. Tentacles not clearly seen. Three series of rather long stigmata, a considerable area between the peribranchial band and the first series. A delicate muscle band present (?) in the interserial spaces. Endostyle strongly curved from the contraction of the sac, but not tortuous.

Digestive apparatus.—Loop of intestine very wide, its transverse diameter frequently greater than its longitudinal; esophagus exceedingly narrow, issuing from middle of posterior end of branchial sac. Stomach of liberal size, smooth-walled, nearly globular. Intestine thickest at pyloric end, and gradually tapering to the rectum which seems to terminate at the deep recto-esophageal constriction though found by careful examination to extend to atrium (pl. xxix, fig. 28).

Reproductive apparatus.—A single large ovum appears to constitute the ovary; situated on the left-posterior surface of the intestinal loop. The single spherical lobe constituting the testis nearly as large as the ovum, and wholly on left side of the intestinal loop. About four (?) coils to the vas deferens. Embryos not found, though both ova and sperm apparently near maturity.

This species is very closely related to *D. inarmatum* v. Drasche (*Didemnooides inarmatum* Lahille); but differs from it in possessing calcareous spicules in the test and in lacking the black pigment patterns characteristic of that species and also in possessing the recto-esophageal

constriction mentioned in the diagnosis. The absence of this latter character in *D. inarmatum* may be inferred from Lahille's statement that the digestive tube does not differ here from the ordinary *Didemnum* form. One might doubt the constancy of this character in *D. strangulatum*, but for the fact that it is present in zooids not yet fully grown. From all that can be learned from the material available, it seems that the abdomen, cut away from the thorax at this point, becomes freed from the test in some way, and so liberates the embryos into the water. I have been able to pick out a number of such severed abdomens from the test, where they lay merely embedded in shallow pits in the surface layer.

D. strangulatum is also rather closely related to *D. cereum* Giard, but is readily distinguished from this species by its narrower branchial and longer atrial siphon and by its peculiar recto-esophageal neck.

The specific name chosen has reference to the cutting off of the isthmus that connects thorax and abdomen.

Kadiak Island, Alaska, July 3, 1899. Dredged in St. Paul harbor in about twenty fathoms. Four colonies in the collection, the smallest about 6 mm. in diameter, all on fragments of molluscan shells.

AMAROUCIUM TRANSLUCIDUM sp. nov.

(Pl. xxx, figs. 29 and 30.)

General characters of the colony.—In unusually regular conical masses, the attachment being by the apex of the cone, which generally constitutes a short peduncle. Frequently, several of these masses are united by their peduncles. Upper surface, forming the base of the cone, gently arched. A longer and a shorter diameter to the base of the cone at right angles to each other.

Size of largest mass in collection: height 15 mm., greatest transverse diameter 20 mm., least 15 mm. Height of all the masses nearly the same, and the other dimensions much more uniform for all the specimens than is usual among a series of specimens of Compound Ascidians.

Color.—Light red, not confined to the zooids but diffused throughout substance of test. Test unusually transparent for this genus, and the zooids very plainly seen through it.

Zooids.—Numerous, rather large, closely crowded, and regularly placed; systems hardly recognizable except in young colonies. Common cloacal orifices few, apparently becoming obliterated in the older colonies, rather large and distinct in the smaller ones. About 10 mm. long as measured in the test of preserved colonies, very straight and

regular, not contracted away from the upper surface of the colony; the three divisions of the body, as seen in their natural position in the colony conspicuously set off from one another, the post-abdomen by its light reddish yellow color and by its abrupt constriction from the abdomen, the abdomen by its pale dirty green and by its shortness and thickness, and the thorax by its ashy color and prominent endostyle. As a rule the thorax and abdomen combined seem to constitute nearly one-half the length of the entire body, as seen with the zooids in place in the colony; in reality, however, the post-abdomen is considerably longer than these two together (pl. xxx, fig. 30).

Test.—Not great in quantity, because the zooids are so closely crowded; no bladder cells or vessels present; cells small, numerous, often containing pigment, particularly in surface layers.

Mantle.—Very delicate; longitudinal muscle fibers arranged in a few definite bands; circular muscles almost wholly wanting.

Branchial apparatus.—The six lobes of the branchial siphon sometimes short and broad, sometimes rather long and slender; constant in number. Atrial siphon short; its languet usually long and pointed, frequently trifid. Branchial tentacles counted with difficulty; about ten or twelve in number, of unequal sizes, situated very near the branchial siphon. Branchial sac about 3 mm. long and 2 mm. deep. Usually ten (rarely nine or eleven) series of stigmata; in one zooid (immature?), only seven; the individual orifices long and narrow and very regular. About eighteen or twenty stigmata in each half series. The interserial vessels narrow; a rather delicate muscle band in each.

Digestive tract.—Intestinal loop short (never as long as the branchial sac) and wide. Esophagus very short, in preserved specimens usually hardly recognizable; loop of the intestine behind the stomach also very short. Distal portion of the ascending limb of the intestine lying at the left side of the stomach and esophagus, rather than dorsal to them, thence turning almost with a right angle to reach, in its rectal portion, the left dorsal aspect of the branchial sac. The form of the intestinal loop thus approximates the twisted condition of this organ as found in *Polyclinum* (pl. xxx, fig. 30).

Stomach large and prominent, nearly globular, but generally somewhat broader than long, its position slightly transverse to the general long axis of the animal. Folds in the wall numerous (twenty or more), many of them very regular and extending without interruption the entire length of the organ. In some cases, they are broken up into islands, some elongated, others nearly round; in others the folds branch and anastomose with one another. On the dorsal-sinistral side a nar-

row, elliptical area with no folds; the folds in the immediate vicinity of this disposed at an angle rather than parallel to it.

Reproductive organs.—Many embryos present in the atrial chambers of many of the zooids, but the sexual glands unusually inconspicuous; in many zooids not recognizable at all without particular attention. Ovary situated far behind the intestinal loop, though in some cases, apparently only a short distance behind it.

This *Amaroucium* bears a strong superficial resemblance to an undescribed species of *Synoicum* from the coast of California, and was at first supposed to be this or a closely allied form, but more careful study removed all doubt about the genus to which it belongs. As mentioned in the diagnosis, and shown by the figures, there appears at first sight to be no grouping of the zooids into systems; and the true state of things was ascertained only after this point had received special attention. It would seem that the common cloacal orifice becomes wholly obliterated in most of the colonies, the zooids then becoming as uniformly distributed as they are in genera like *Distoma*, in which each atrial siphon opens by itself. What the method of exit of the excreta is in these conditions, I am not sure, as I have not been able to detect any single orifices. The long atrial languets may be seen embedded in the test, and apparently the siphons to which they belong have, in most cases, no openings to the surface of the colony. In a few colonies, particularly those of small size, an occasional rather large and conspicuous common cloacal orifice may be seen.

The species is more closely related to *Amaroucium proliferum* M. Edw. than to any other, particularly if this species is held, as Lahille believes it should be, to include several forms that have been described by other authors as separate species. From all the varieties of *proliferum* the present form differs, however, in the absence of composite or ramified colonies characteristic of *proliferum*, in the smaller size of the masses, the less distinct systems of the zooids, and the greater regularity of the folds of the stomach wall. The specific name refers to the unusual transparency of the test.

Found at Orca, Prince William Sound, Alaska, on reefs at low tide. Collected June 26, 1899. About one hundred colonies in the collection.

AMAROUCIUM COEI sp. nov.

(Pl. XXIX, figs. 31 and 32.)

General characters of the colony.—In large pear-shaped masses, many of them loosely joined together by their narrow bases. The masses, as a rule, very regular in form, the expanded end nearly cir-

cular in outline, the upper part domed and oversetting somewhat, particularly in large specimens, the regularly narrowing smaller, or peduncular part. The upper surface somewhat uneven by the projection of the systems which are distinct in life, though considerably obscured in the preserved specimens; six or seven zooids in each system.

Color.—Light salmon, nearly uniform throughout, zooids more highly colored than test. In preserved condition color uniform ashen with tinge of green; test somewhat transparent so that the zooids show through rather indistinctly, at the sides, and scarcely at all on the upper surface.

Size.—Of largest mass: Height 58 mm., of peduncular portion 31 mm., of dome 33 mm., thickness in thickest part 43 mm. (cross section a circle). Of a medium sized mass: Height 33 mm., of peduncular part 20 mm., of dome 10 mm., thickness in thickest part 20 mm. by 24 mm.

Test.—Cells very numerous and relatively large, but no bladder cells.

Zooids.—Extremely long and slender, thorax very small in proportion to entire zooid; total length about 25 mm., thickness in thickest place about 2 mm. Of this length (measurements on preserved specimens, though contractions not great), thorax 4 mm., abdomen 5 to 7 mm., post-abdomen 21 mm. Not very closely crowded, rather regularly distributed, placed nearly parallel with one another; few (not more than six or seven) in a system. Not much contracted except as to thorax; easily removed from test.

Mantle.—Musculature feeble, a few small, irregular, longitudinal bands.

Branchial apparatus.—Branchial orifices (in life) moderately large, not visibly lobed or with other characteristic marks; common cloacal orifices distinct, not lobed. Branchial orifices (in preservation) not recognizable, cloacal much obscured. Both siphons rather long and narrow and much alike; branchial six-lobed, the lobes always broad and low; atrial also obscurely and irregularly lobed, usually the dorsal side extended more or less to produce an imperfect atrial languet, though frequently showing no intimation of this structure.

Branchial tentacles around the branchial orifice about seventeen, of several sizes, some very short; in a close bunch, as seen in dissections.

Branchial sac very small for the size of the zooids. Series of stigmata varying from eleven to fifteen, the individual orifices small and regular; muscle bands in interserial spaces of moderate development. Dorsal languets at least as numerous as the series of stigmata; rather long.

Digestive apparatus.—Enteric loop as a whole rather long (twice as long as branchial sac in most of the zooids with latter somewhat contracted), narrow, straight; esophagus rather longer than stomach; stomach distinct but not prominent, usually somewhat longer than broad; folds of the wall well defined, extending throughout its length, usually regular but sometimes broken and anastomosing. Loop of intestine very narrow; ascending limb taking the course usual for the genus, but owing to the narrowness and length of the loop and the small size of the branchial sac having inconspicuous windings. Loop as a whole very straight.

Post-abdomen and reproductive apparatus.—Former very long and slender and of uniform diameter for most of its length; not dense with food material and sexual products. Ovary a short distance behind intestinal loop, rather small; testis beginning immediately behind the ovary and extending through almost the entire remaining portion of post-abdomen; masses regular in size and form, nearly spherical, not crowded. Vas deferens distinct.

Although this species is devoid of characters that differentiate it strikingly from a number of other species, it is still impossible to identify it with any of them, and several of the differentia are important. In the form and size of the colony it is strikingly like *A. figarium* Ritter (MS.) from the coast of California; but the surface of the test of this latter species is firmly incrustated with sand, while that of *A. coei* is peculiarly devoid of sand or other foreign substances. The most striking difference between the two is found in the zooids. The length of the entire animal is about the same in both, but the branchial sac of *figarium* is three or four times as large as that of *coei*. In *coei* the folds of the stomach wall are much more numerous and distinct than in *figarium*. Various other trivial but constant differences might be mentioned. Another species with which it has much in common is *A. blochmanni* Heiden.¹ From this it differs, however, in its less distinct peduncle, larger size of the masses, smaller number of stigmatic series, length and character of the atrial languet, and in the greater distinctness and regularity of the folds of the stomach. It gives me pleasure to name this species after my friend and efficient fellow-collector on this expedition, Dr. W. R. Coe.

Taken with the dredge, near the wharf in St. Paul harbor, Kadiak, on July 3, 1899, in a few fathoms, rocky bottom, with coarse pebbles and shells. Apparently very abundant here, as every haul brought up a number of specimens.

¹ Zool. Jahrb., Band VII, 1894.

AMAROUCIUM CALIFORNICUM (?) Ritter.

Amaroucium californicum RITTER, Ann. N. Y. Acad. Sci., Vol. XII, No. 14, p. 608, 1900.

A few small colonies of an *Amaroucium* found at Popof Island are doubtfully identified with this species. The chief difficulty in the way of identification is in the small size of the zooids and the fungiform shape of the colonies in the specimens at hand. It is highly probable, however, that none of the colonies are really typical. None of the zooids are sexually mature, and in one colony, the largest, most of them are in a broken-up, degenerate condition, indicating that the general form is flat and expanded, and that the fungiform pieces are in reality only incidental. Such knobs are very common in *A. californicum*.

The zooids are all so contracted that it is impossible to make out much about their internal structure, but so far as one can see there is nothing here in the way of the identification.

Taken on shore rocks at low tide, Popof Island, Shumagin Islands, July 8, 1899.

PSAMMAPLIDIUM PEDUNCULATUM (?) Herdman.

Psammaphlidium pedunculatum HERDMAN, Linn. Soc. Journal, Zool., Vol. XXIII, p. 620, 1891; and Catalogue of Tunicata in Australian Museum, No. XVII, p. 88, and Pl. VI, figs. 7-9, 1899.

The identification of the specimens with this species is very doubtful. This assignment is provisional only, pending an opportunity to examine more material.

Meantime the following points may be noted, mostly supplementary to Herdman's description, but to some extent obviously at variance with it:

Form of the club-shaped masses constituting the colonies essentially the same as in the Australian specimens, though probably the size is slightly larger in the Alaskan species.

Color.—Cherry red in life, this, however, disappearing in preserved condition except a slight tinge particularly noticeable around the siphons.

Zooids.—Arranged in very distinct systems of about a dozen each; one or two systems only to each lobe. Common cloacal opening large and distinct. Zooids much contracted and very opaque. A distinct, though not long, single pointed atrial languet. About twelve series of branchial stigmata. Stomach rather large, though not clearly set off from the intestine, which is also large. A single narrow longitudinal

fold on the left side of the stomach triangular in form with very narrow base directed toward the posterior end of stomach, the apex reaching nearly, though not quite, to the anterior end.

Post-abdomen very dense and opaque; gonads not recognized.

Comparison of the points here noted with Herdman's description, will show that the color of the colony, the distinct systems, and the character of the stomach offer the chief difficulties to the identification of the two forms as one species.

Dredged at Sitka in about ten fathoms, June 15, 1899. A single colony with two lobes.

BOTRYLLUS MAGNUS sp. nov.

(Pl. xxx, figs. 33-37.)

General characters of the colony.—Flat and incrusting, though with a tendency to lobulation in some parts. Found on the under side of rocks, to which it clings very closely. Irregular in outline, several mm. (five or six) in diameter, 3 or 4 mm. thick, with pronounced lobes here and there. Dusky purple in color, uniform in all parts, and showing practically no variation from colony to colony. Systems distinct, circular, regular. Five to eleven zooids in each system. Common atrial orifices large, lobed, having as many lobes as zooids. Each branchial orifice standing somewhat above the general surface. The ectodermal vessels and ampullæ in the test numerous; the ampullæ at the margins of the colony much longer than thick; those in other portions shorter. A mass of brown pigmented cells in the ampullæ (pl. xxx, fig. 37).

Zooids.—Large, 3.5 or more mm. long; 2.5 mm. broad. General form that of a cylinder slightly curved with the convexity dorsal and the ends nearly truncate. Full grown individuals rather opaque from the considerable quantity of mesenchymatous material (?) and blood in the mantle. Musculature of mantle exceedingly weak; a few scattered fibers in the anterior end only, confined chiefly to the siphons.

Branchial apparatus.—Branchial orifices distinct on surface of colony; circular, not lobed, projecting slightly above the general level. Six branchial tentacles projecting into the siphon in the living colonies. Branchial siphon short and wide. Atrial siphon wide and frequently of considerable length; provided with a prominent ventral lip and with a wide single-pointed dorsal languet of very variable length, wanting in young zooids (pl. xxx, figs. 35 and 36).

Tentacles about sixteen, eight moderately long, and eight slightly shorter alternating with these. Eleven to thirteen series of stigmata

with about twenty stigmata in each half series; the individual stigmata when fully grown about four times as long as broad; border cells distinct. Interserial spaces narrow and without muscle fibers. Three internal longitudinal bars on each side. The dorsal lamina, as seen through the animal, a plain narrow membrane, resembling one of the internal longitudinal vessels.

Digestive apparatus.—Situated on the left side of and projecting but very slightly behind the branchial sac at the posterior end. Esophagus issuing from the postero-dorsal angle of the sac; nearly as long as the stomach. Stomach situated nearly transversely to the sac, and extending somewhat more than half way across it, having its pyloric and cardiac ends about equally remote from the dorsal lamina and endostyle respectively. Stomach about one-third longer than broad; slightly curved, the convex side looking backward. Wall with about eight or ten double folds which extend the entire length of the organ. The intestine behind the stomach in the form of an open S, with the rectal limb considerably longer than the pyloric and quite straight. The rectum reaching forward in the cloaca anterior to the middle of the sac. Anus usually showing more or less of a lip. The post-gastric intestine nearly uniform in diameter throughout.

Reproductive apparatus.—Gonads on both sides of the body; immature and very small in all the material at hand. Budding zooids abundant; two buds, one on each side, on each budding individual.

The specific character particularly relied upon for this form, viz. the large size of the zooids, is a strong point in favor of regarding it as belonging not to *Botryllus* at all, but to *Polycyclus*, and I am much inclined to believe that its closest affinities are in reality with *P. Szignyi* Herdman. According to prevailing views regarding the generic characters of the Botryllidæ, however, the comparative thinness of the colony and the softness of the test require that it be placed in the genus *Botryllus*. The large size of the zooids, the uniformity of color of the colonies, and the relative nearness of the atrial to the branchial siphon make it a rather distinct species in this genus.

A single colony dredged in about 20 fathoms at Kadiak Island; about a half dozen colonies found on rocks at low tide at Popof Island, Shumagin Islands, July 8, 1899.

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ABBREVIATIONS USED IN THE FIGURES.

- a. s.*—atrial siphon.
b. s.—branchial siphon.
d. l.—dorsal lamina.
d. l'g's.—dorsal languets.
ec. ap.—ectodermal appendages.
f. f.¹f.²f.³—folds of branchial sac.
g. g.—ganglion-gland.
gon.—gonads.
hy.—hypophysis.
m. f.—muscle fibers.
ov.—ovary.
P.—peduncle.
p. i.—intermediate papillæ of branchial sac.
r. b.—terminal bulb of rootlets.
r. c.—rectum.
r. l.—ultimate rootlets.
st.—stomach.
tst.—test.
tes.—testis.
tst. c.—test cells.

PLATE XXVII.

FIGS. 1 to 5. *Ascidia adhærens*.

- 1 and 2 are habit sketches, 1 showing particularly the way in which the animals aggregate together to form a continuous flattened layer. The position of the atrial siphon somewhat on the upper surface is shown. Natural size.
3. Left side of animal, dissected from the test.
4. Portion of peripharyngeal field showing a portion of the tenacles, the hypophysis mouth, the gland-ganglion mass, *s. s.*, and the dorsal lamina, *d. l.*, with its few, simple marginal teeth.
5. Small portion of branchial sac drawn with special reference to the irregularity in distribution of the intermediate papillæ, *f. i.*; *i. c.*, their presence or absence in the intervals between the transverse vessels.

FIGS. 6 to 9. *Molgula graphica*.

6. Habit sketch, seen from right side. Enlarged 2 times.
7. Left side of animal, dissected from test.
8. Portion of peripharyngeal field; *s. s.*, the gland ganglion mass.
9. One of the much branched tentacles. The extent of the branching, and the rolling up of the ultimate branches is even more pronounced in the specimen than is here shown.

FIGS. 20 and 21. *Styela yakutatensis*. Natural size.

FIGS. 22 and 23. *Styela truncata*. Natural size. Fig. 22 suggests the aggregation of the individuals and 23 shows the general conical form and the truncation of the basal end.

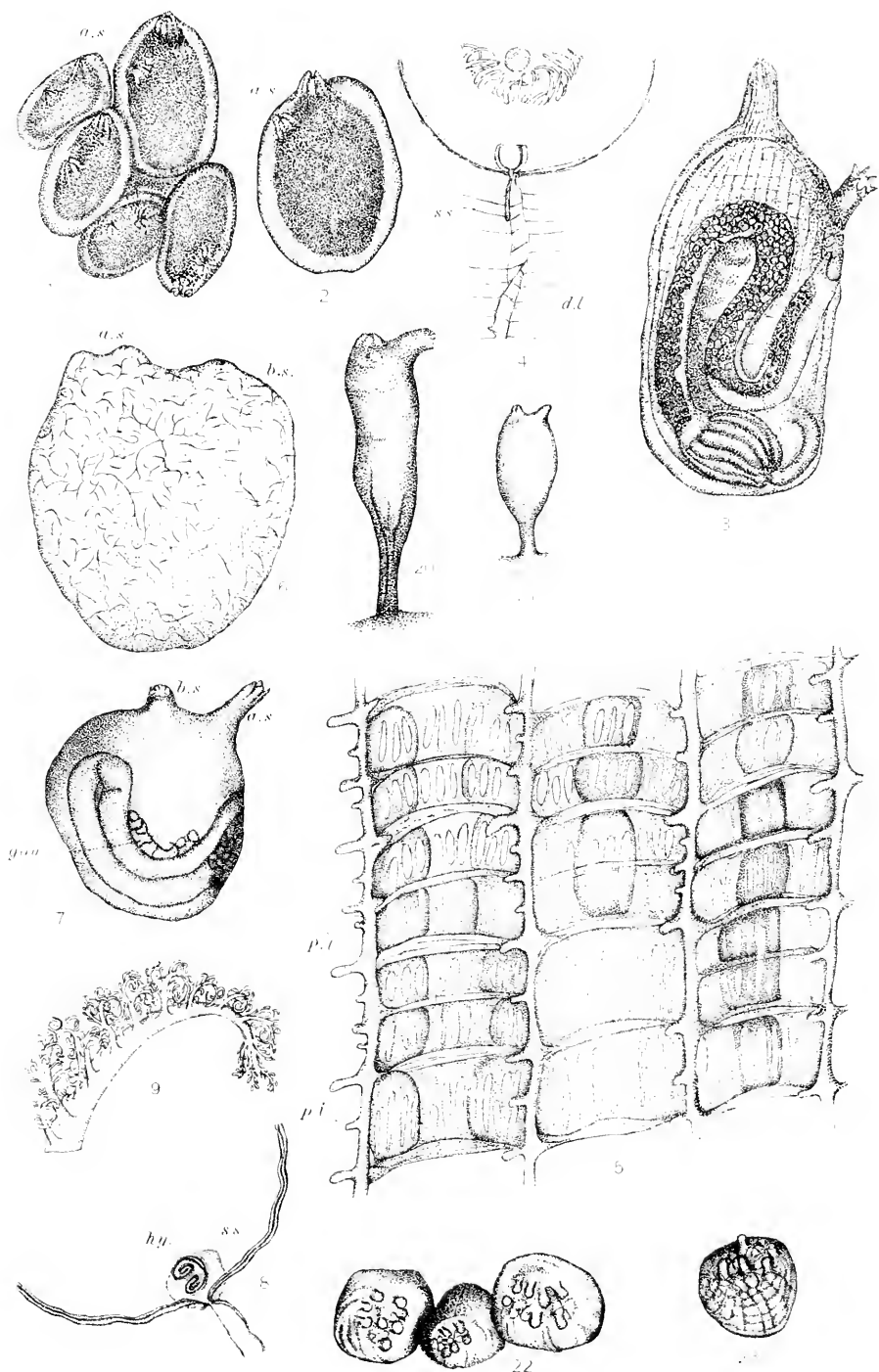


PLATE XXVIII.

FIGS. 10 to 19². *Rhizomolgula arenaria*.

10. Habit sketch. Natural size. The method of drawing makes it impossible to successfully show the sand on the surface.
11. Left side of animal dissected from the test. The stomach (*st.*) with its well-defined ribs is shown, as is also the peculiar coiled-up condition of the material within the intestine.
12. View of orifices of anterior end with test removed.
13. Portion of peduncle (*P.*) with numerous rootlets, some showing the bulbous terminations (*r. b.*). ($\times 15$).
14. Magnified view of main stem of peduncle (*P.*) with a single rootlet (*r. t.*) arising from it. This shows its single muscle fiber (*m. f.*) continuing up into the peduncle.
15. Branching rootlet showing how the single muscle fiber of the ultimate rootlet (*r. t.*) reaches into the larger portion of the branch.
16. Optical section of portion of a peduncle; its outer edge marked by the test (*tst.*); bundle of muscle fibers (*m. b.*). A single muscle fiber (*m. f.*) is separated from the general mass and is clearly seen imbedded in the test with test cells (*tst. c.*) entirely surrounding it.
17. Similar to last but more clearly showing the tendency of the test cells to become elongated.
18. Portion of branchial sac showing four folds (*f. f.*¹*f. f.*²*f. f.*³). The folds *f.*¹ and *f.*² are spread apart to bring out the infundibulæ and the internal longitudinal vessels confined to the folds.
19. Portion of peripharyngeal field.
- 19¹. Small piece of mantle showing the papillæ.
- 19². One of the papillæ, magnified, showing its wall and lumen.

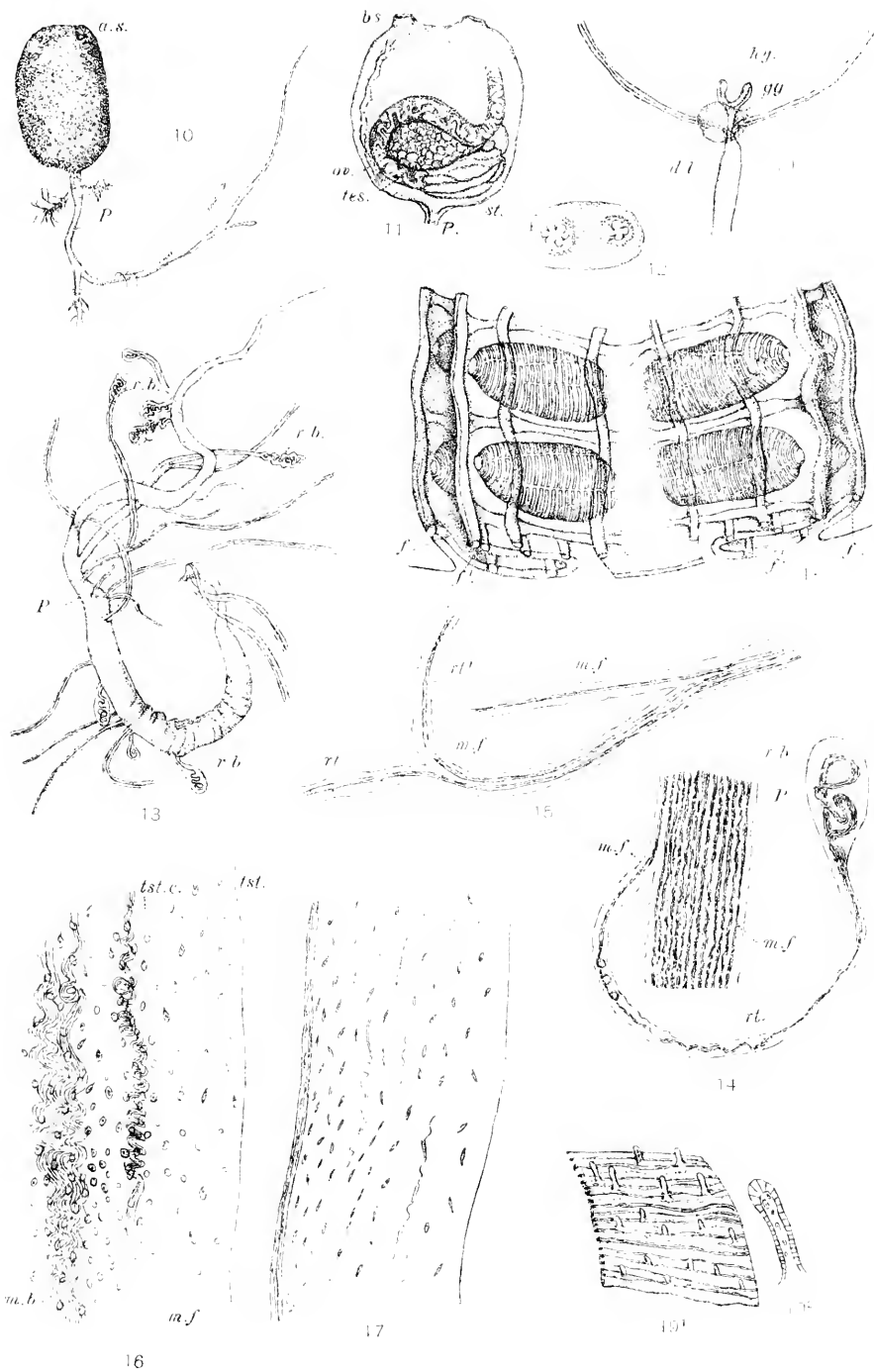


PLATE XXIX.

FIGS. 26 and 27. *Distaplia confusa*. ($\times 17$.)

26. A mature zooid. An approach to the dumbbell shape, characteristic of many species of *Distoma* is shown, though imperfectly, in this figure.

27. An immature zooid. The difference in the character of the stomach walls of 26 and 27 is noteworthy.

28. *Didemnum strangulatum*. ($\times 17$.) Atrial siphon (*a. s.*); end piece of the rectum (*r. c.*) nearly cut off along with the esophagus, by the constriction.

FIGS. 31 and 32. *Amaroucium coci*.

31. Natural size.

32. Zooid, much enlarged.



PLATE XXX.

FIGS. 24 and 25. *Distoma pulchra*.

24. Several bunches. Natural size.

25. Thorax of immature zooid. The specimen was dissected from the test and cut lengthwise nearly in the sagittal plane. The figure represents the left side. The cut passed to the left of the endostyle and to the right of the dorsal languets.

FIGS. 29 and 30. *Amaroucium translucidum*.

29. Slightly less than natural size. Usually more masses than are here shown are joined together.

30. Zooid much enlarged.

FIGS. 33 to 37. *Botryllus magnus*.

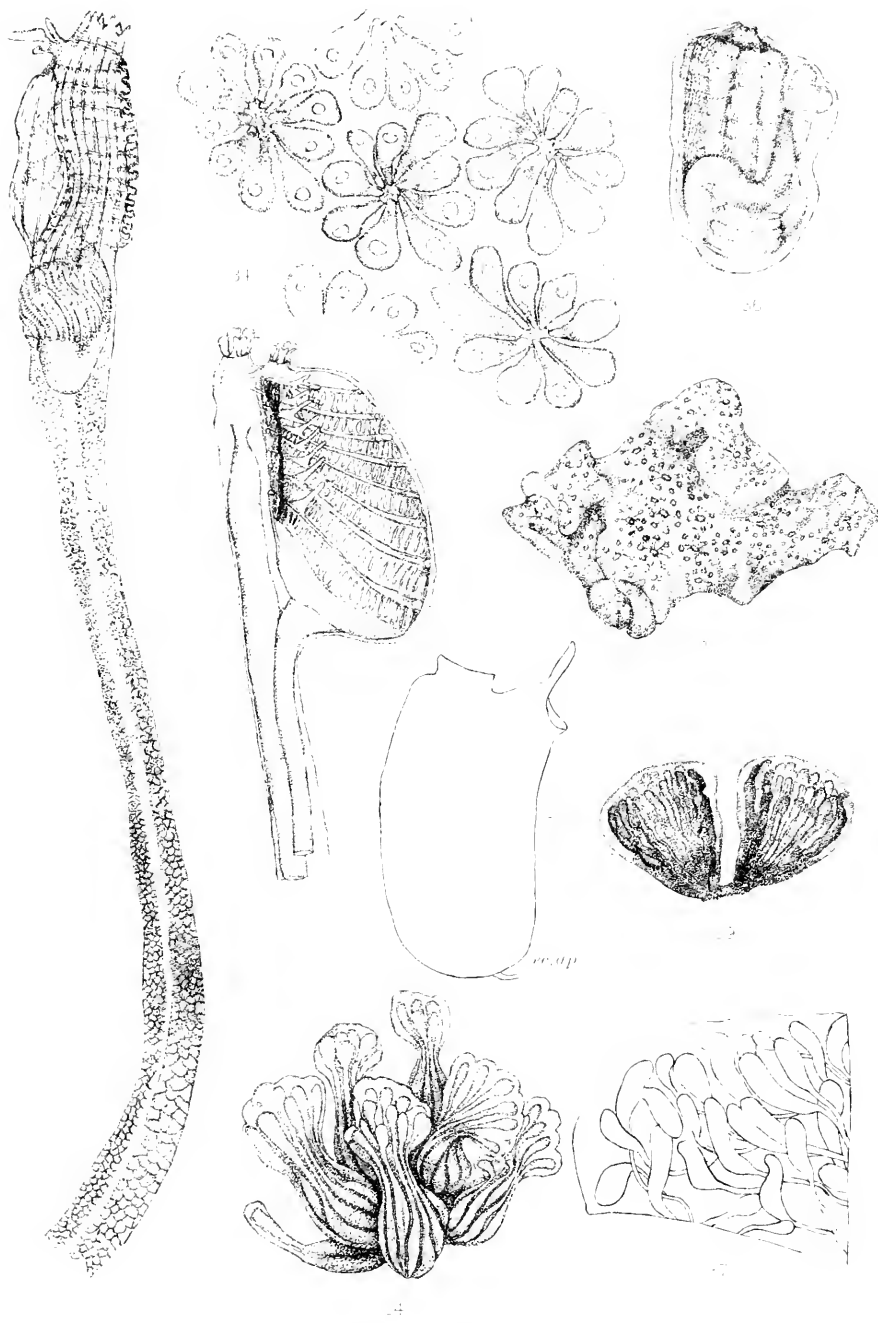
33. Part of a colony. Natural size.

34. A few of the systems.

35. Outline of adult zooid. ($\times 16$.)

36. Young zooid. Atrial languet not yet developed.

37. Piece from the margin of a colony, showing the ectodermal vessels with their ampullæ.



PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. III, PP. 267-272.

PLS. XXXI-XXXII

JULY 13, 1901.

A NEW SPECIES OF OLENELLUS FROM THE
LOWER CAMBRIAN OF YORK COUNTY,
PENNSYLVANIA.

BY ATREUS WANNER.

REFERENCE is made by Mr. Charles D. Walcott, in Bulletin No. 134, United States Geological Survey, to the *Olenellus* fauna of the York county, Pennsylvania, Cambrian. At that time fragmentary impressions of trilobites had been collected, but no locality had yielded specimens that could then be referred with certainty to any described species of *Olenellus*. I have recently found complete specimens of several species, one series illustrating different stages of growth and presenting variable features of *Olenellus thompsoni*. One new species of the subgenus *Holmia* is beautifully preserved and I take pleasure in naming it after Mr. Walcott in recognition of his work on the Cambrian faunas.

OLENELLUS (HOLMIA) WALCOTTANUS sp. nov.

(Pl. xxxi, figs. 1, 2; Pl. xxxii, figs. 1, 2, 3, 4.)

General shape of entire specimen (Pl. xxxi, fig. 1) ovate; width about two-thirds of length.

Transverse diameter of cephalic shield about twice the longitudinal; marginal furrow shallow; rim of moderate and nearly uniform width, being apparently narrowest in front of the glabella and terminating in two postero-lateral spines. In all the specimens found, the anterior part of the rim is obscured and evidently narrowed by the flattening

and forward thrust of the large frontal segment of the glabella. A low narrow ridge extends along the posterior margin of the cephalic shield.

The anterior marginal fold is striated by closely placed parallel lines, conforming to the curvature of the perimeter and occasionally inosculating.

There are prominent and moderately long genal spines and the base of a meso-occipital spine.

The anterior part of the glabella, evidently originally hemispherical and very prominent, is flattened and pushed forward in all the specimens found. The glabella is widest across the middle of the prominent frontal lobe, uniformly narrowing to the posterior lobe. The posterior part is divided into four transverse ridges by the occipital furrows and three additional pairs extending nearly to the top.

Eyelobes crescentiform and prominent, with a raised rim around the outer margin, curving outward from the posterior part of the frontal lobe of the glabella and terminating in front of the occipital furrows.

Thoracic segments seventeen; median lobe strongly convex, the base of a spine extending across the middle of each segment.

Pleura slightly curving part way and then strongly falcate; channelled with a broad groove, extending to half the length of the pleura and where the grooves terminate, presenting a prominent line of demarcation, beyond which the flattened and broad extremities curve more sharply downwards. Posterior pairs of pleura strongly incurving and inclosing the pygidium.

Beyond the termination of the pleural groove, closely placed transverse folds, overlapping each other at short intervals, finely fret the surface with short, curved, inosculating lines.

The strongly falcate ends of the pleura increase in relative length towards the pygidium, attaining their greatest extension shortly anterior to the ultimate pair of pleura.

With the exception of the falcate ends of the pleura and part of the pygidium a network of incised lines (Pl. xxxi, fig. 2) ornaments the surface dividing it into minute hexagonal, or pentagonal, plates. In all casts of the surface the inosculating lines are raised above the enclosed spaces.

Pygidium small, circular; extending but slightly further longitudinally than its transverse width along the line of attachment. The posterior margin (Pl. xxxii, fig. 4) parted in the middle by a triangular incision penetrating about one third of the distance across. In this specimen, the triangular incision is open and the pygidium, together with the thoracic segments, somewhat fore-shortened; in Pl.

xxxI, fig. 1, the margins of the incision are pushed together and the pygidium narrowed. In the one case, pressure on the matrix was exerted longitudinally, and in the other, laterally. Thus in the two specimens are presented opposite effects of like pressure, results that must be considered in forming a conception of the shape of a specimen free from all distortion due to pressure.

For about half the distance to the posterior end, the pygidium presents a slightly raised surface. The curved lines, on each side of the thoracic segment, marking the ends of the pleural grooves, extended to meet, follow the margin of this overlapping fold and unite at its middle point.

The anterior half of the pygidium is marked by transverse lines similar to those on the falcate ends of the pleura.

Associated with the entire specimen (Pl. xxxI, fig. 1) is a doublure with hypostoma attached. The doublure (Pl. xxxII, fig. 2) is partly overlapped by the cephalic shield of which it was evidently once a part. Its inner margin is beaded by a row of closely placed and deep indentations which are still more strikingly and clearly presented in part of another doublure (Pl. xxxII, fig. 1).

The attached hypostoma, whilst distorted, presents enough of its serrated lateral margin to identify it with the entire specimen (Pl. xxxII, fig. 3) from the same locality.

The immediate anterior margin is entire, but its lateral extension, on each side, is serrated, bearing six teeth. The number of teeth, as determined by all the hypostomas I have thus far found, seems to be constant. Moreover the fact that, in the same localities, specimens of *Olenellus thompsoni* are found in greater abundance than those of *Olenellus walcottanus*, and that the type (Pl. xxxII, fig. 3) illustrates the only form of hypostoma observed, justifies the conclusion that the hypostomas of both species are essentially the same in characteristic features.

Formation and Localities.—Lower Cambrian, argillaceous shales, about three miles north and northwest of York, Pennsylvania, near the contact line of Cambrian and Trias.

PLATE XXXI.

Olenellus (Holmia) walcottanus.

- FIG. 1. A nearly perfect specimen crushed flat in the shale and with the exterior shell largely exfoliated.
2. A segment of the thorax greatly enlarged, showing the ornamentation of the exterior surface, and on the falcate portion the inosculating lines marking the surface of this portion of the segment.

(270)

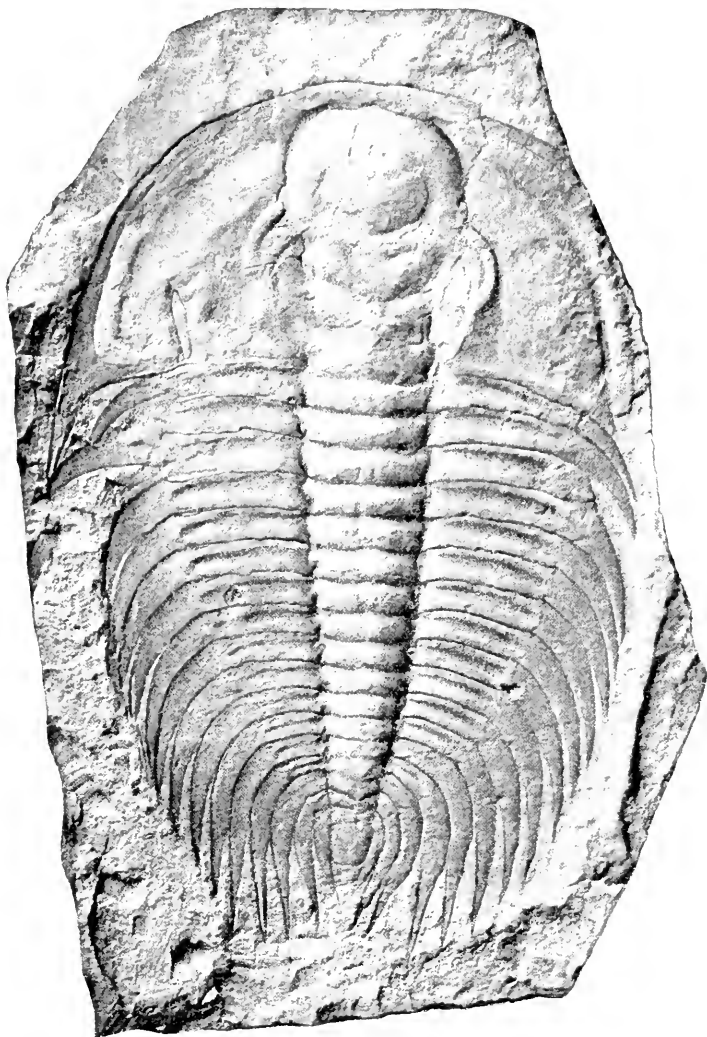


Fig. 1

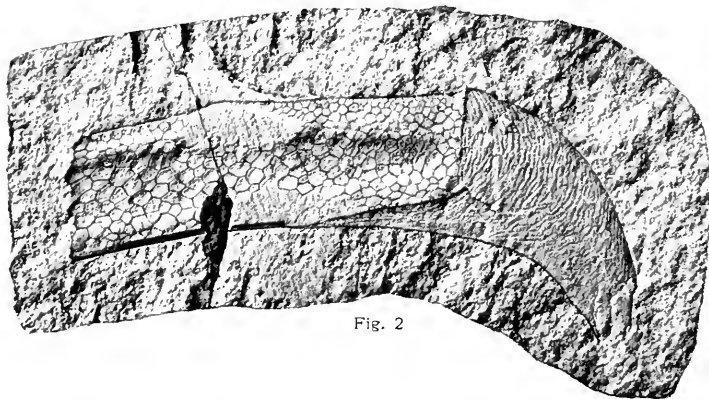


Fig. 2

PLATE XXXII.

Olenellus (Holmia) walcottanus.

- FIG. 1. Cast of the under side of the doublure, showing the pits formed by the semi-spinose inner margin.
2. A hypostoma attached to the doublure.
 3. An unusually well preserved hypostoma, showing the six spines on each side.
 4. An enlargement ($\times 2$) of posterior segments of the thorax and the pygidium, showing the peculiarities of the surface ornamentation.

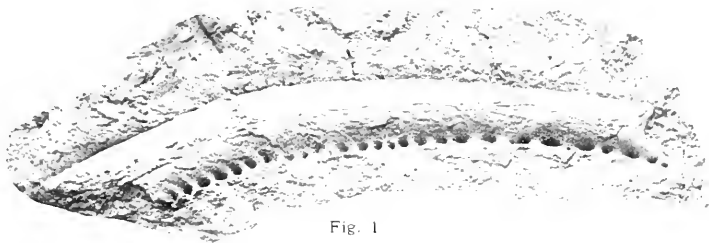


Fig. 1



Fig. 2



Fig. 3



Fig. 4

Olenellus (Holmia) Walcottanus

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VOL. III, PP. 273-295.

JULY 26, 1901.

SYNOPSIS OF THE RICE RATS (GENUS ORY-
ZOMYS) OF THE UNITED STATES
AND MEXICO.

BY C. HART MERRIAM.

THE genus *Oryzomys*, comprising the native American Rice Rats, is of tropical origin and attains its highest development in South and Central America. In Mexico it is generally distributed except in the most arid parts, and is represented by a considerable number of species and subspecies. In the United States it is restricted to the southeast coast region, reaching northward only as far as southern New Jersey.

Nearly all the species are inhabitants of the Tropical and Austral life regions, but in the mountainous parts of southern Mexico and Central America, where boreal types are scarce and often replaced by modified tropical types, a few forms have pushed up into the Boreal zone and developed warm woolly coats and other peculiarities which distinguish them as specialized local species. The boreal mountain forms here described are *crinitus* from mountains bordering the Valley of Mexico, and *rhabdops* and *angusticeps* from mountains in eastern Chiapas and western Guatemala.

Up to the present time 10 species have been described from Mexico and Guatemala (including those from the peninsula of Lower California and the Tres Marias Islands). To these are here added 20 species and subspecies, bringing the total num-

ber up to 30. In addition to these, 4 are known from the United States.

The material on which this paper is based comprises 600 good skins with skulls, 350 of which were collected in Mexico by E. W. Nelson and E. A. Goldman during their field work under the auspices of the Biological Survey of the U. S. Department of Agriculture. All the specimens are accompanied by field notes and flesh measurements.

Thirty-five species and subspecies are here recognized from the United States, Mexico, Guatemala and Nicaragua; these, with their type localities, are:

<i>Oryzomas palustris</i> (Harlan)	Southern New Jersey
<i>natator</i> Chapman	Gainesville, Florida
<i>natator floridanus</i> subsp. nov.	Everglade, Monroe Co., Fla.
<i>aquaticus</i> Allen	Brownsville, Texas
<i>peninsule</i> Thomas	Santa Anita, Lower California
<i>nelsoni</i> Merriam	Maria Madre, Tres Marias Ids.
<i>albiventer</i> sp. nov.	Ameca, Jalisco, Mexico
<i>cozumelæ</i> sp. nov.	Cozumel Id., Yucatan, Mexico
<i>fulgens</i> Thomas	? Valley of Mexico
<i>crinitus</i> sp. nov.	Tlalpam, Federal District, Mexico
<i>crinitus aztecus</i> subsp. nov.	Yautepec, Morelos, Mexico
<i>mexicanus</i> Allen	Tonila, Jalisco, Mexico
<i>mexicanus peragrus</i> subsp. nov.	Rio Verde, San Luis Potosi, Mex.
<i>richmondi</i> sp. nov.	Escondido River, Nicaragua.
<i>jalapæ</i> Allen	Jalapa, Vera Cruz, Mexico
<i>jalapæ rufinus</i> subsp. nov.	Catemaco, Vera Cruz, Mexico
<i>zygomatiscus</i> sp. nov.	Nenton, Guatemala
<i>teapensis</i> sp. nov.	Teapa, Tabasco, Mexico
<i>bulleri</i> Allen	Valle de Banderas, Jalisco, Mexico
<i>rufus</i> sp. nov.	Santiago, Tepic, Mexico
<i>coyesi</i> (Alston)	Coban, Guatemala
<i>goldmani</i> sp. nov.	Coatzacoalcos, Vera Cruz, Mexico
<i>chapmani</i> Thomas	Jalapa, Vera Cruz, Mexico
<i>chapmani saturator</i> subsp. nov.	Tumbala, Chiapas, Mexico
<i>chapmani dilutior</i> subsp. nov.	Huauchinango, Puebla, Mexico
<i>chapmani caudatus</i> subsp. nov.	Comaltepec, Oaxaca, Mexico
<i>palatinus</i> sp. nov.	Teapa, Tabasco, Mexico
<i>hylocetes</i> sp. nov.	Chicharras, Chiapas, Mexico
<i>rhabdops</i> sp. nov.	Calel, Guatemala
<i>angusticeps</i> sp. nov.	Volcan Santa Maria, Guatemala
<i>melanotis</i> Thomas	San Sebastian, Jalisco, Mexico

<i>rostratus</i> sp. nov.	Metlatoyuca, Puebla, Mexico
<i>rostratus megadon</i> subsp. nov.	Teapa, Tabasco, Mexico
<i>yucatanensis</i> sp. nov.	Chichenitza, Yucatan
<i>fulvescens</i> (De Saussure)	Orizaba, Vera Cruz, Mexico

These species fall naturally into four groups, which, from their typical species, may be named the *palustris-mexicanus*, the *chapmani*, the *melanotis*, and the *fulvescens* groups. Two of these, the *mexicanus* and *chapmani* groups, are partly bridged by intermediate forms.

1. The *palustris-mexicanus* group is characterized in the typical forms by rather large size, short ears, large and massive skulls, long incisive foramina, and strongly developed superciliary beads. All of the known large species, and a few of medium size, belong to this group. The members may be arranged in two series according to the color of the underparts, as follows:

(a) White-bellied forms: *palustris*, *nataator*, *peninsulæ*, *albiventer*, *cozumelæ* (sometimes pale fulvous), *nelsoni*, *aztecus*, *mexicanus* (belly sometimes buffy), *bulleri*, *rufus*.

(b) Fulvous bellied forms: *aquaticus*, *cozumelæ* (usually white), *fulgens*, *crinitus*, *jalapæ*, *teapensis*, *zygomaticus*, *goldmani*, *couesi*, *mexicanus* (belly usually white), *mexicanus paragrus*, *richmondi*.

2. The *chapmani* group is characterized by rather small size, dark coloration, and small mouse-like skulls, with only faint superciliary beads. The species are *chapmani*, *palatinus*, *hylocetes*, *rhabdops*, *angusticeps*.

3. The *melanotis* group is characterized by medium size, large dark ears, and relatively short incisive foramina. The species are *melanotis*, *rostratus*, *yucatanensis*.

4. The *fulvescens* group is characterized by extremely small size, yellowish fulvous coloration, tiny thin and papery, mouse-like skulls, without supraorbital beads, resembling the smaller species of *Reithrodontomys*. Only one species has been described. It is smaller than a house mouse, has a yellowish fulvous body, long and slender tail, and rather large black ears. If of larger size it would doubtless be separated into subspecies.

In studying the species of *Oryzomys* it is very necessary to use skulls of fully adult and even old individuals, as in many forms the specific characters do not develop until rather late in life. The males are larger than the females and usually have the characters more accentuated. The cranial characters that have proved most useful are the form and thickness of the zygomatic arches, length and breadth of rostrum, form of nasals, degree of development of supraorbital (or superciliary) beads, size and form of incisive foramina (or palatal slits), and size of molar teeth.

ORYZOMYS PALUSTRIS (Harlan).

Mus palustris HARLAN, Am. Journ. Sci. and Arts, xxxi, No. 2, pp. 385-386, 1837.

Hesperomys (Oryzomys) palustris BAIRD, Mammals N. Am., 482, 1857.

Oryzomys palustris texensis ALLEN, Bull. Am. Mus. Nat. Hist., Vol. vi, 177-179, May 31, 1894.¹

Type locality.—Southern New Jersey (near Salem, Delaware Bay).

Characters.—Size medium or rather large (about equaling a half-grown house rat, which the animal greatly resembles); ears rather small; tail rather short; color grayish; belly white.

Color.—Upperparts grizzled grayish brown: sides somewhat buffy; back copiously mixed with black hairs; underparts white, the slaty underfur showing through; tail dusky above, whitish below; feet whitish.

Cranial characters.—Skull of medium size, somewhat flattened, with moderately developed superciliary beads; rostrum elongate; nasals long and tapering, wedgeshaped, ending about on plane with premaxillæ; zygomata rather narrow, their outer sides nearly parallel; palatal slits exceedingly long. Skull very like that of *mexicanus* but flatter, nasals longer and less decurved; palatal slits longer.

Measurements.—Average of 9 specimens from Raleigh, N. C.: total length 231 mm.; tail vertebrae 117; hind foot 29.

NOTE.—In the absence of specimens from the type locality (southern New Jersey) the above description has been drawn from specimens from Dismal Swamp, Va., and Raleigh, N. C.

¹ I am unable to distinguish Allen's subspecies *texensis*, either externally or by the skulls, from *O. palustris* from Raleigh, N. C., and Dismal Swamp, Va. The braincase may average a trifle narrower, but the difference is very slight.

ORYZOMYS NATATOR Chapman.

Oryzomys palustris natator CHAPMAN, Bull. Am. Mus. Nat. Hist., Vol. v, pp. 44-46, March 17, 1893.

Type from Gainesville, Florida.

Characters.—Size very large; ears short; tail long; pelage long and full; color fulvous brown with an extensive dark dorsal patch; underparts white; skull large, long and massive; general appearance of upperparts suggesting the muskrat.

Color.—General color of upperparts grayish bister, becoming buffy gray on sides, and buffy fulvous on rump and posterior back; head and back darkened by copious admixture of long brownish black hairs which are so profusely abundant as to form a broad, ill-defined patch covering the greater part of back and rump; underparts white, the slaty underfur showing through; tail brownish black above, soiled whitish below.

Cranial characters.—Skull large and massive, elongate, flattened on top, with strongly projecting everted superciliary ridges, which greatly increase the breadth across the orbits posteriorly; zygomata moderately spreading; palatal slits large and open. Compared with *palustris* the skull is much larger and heavier, with broadly expanded supraorbital ridges and much larger and more broadly open incisive foramina.

Measurements.—Average of 6 males from Lake Kissimmee, Fla.: total length 295 mm.; tail vertebræ 151; hind foot 35.

Remarks.—Specimens from Cape Canaveral agree in color with *natator* but are decidedly smaller. Their skulls are intermediate between those of *natator* and *palustris*.

ORYZOMYS NATATOR FLORIDANUS subsp. nov.

Type.—From Everglade, Monroe County, Florida. No. 71349, ♂ ad. U. S. National Museum, Biological Survey Coll. March 29, 1895. J. Alden Loring. Original number 2819.

Characters.—Similar to *natator* but much smaller, with cheeks and sides more inclining to fulvous; skull decidedly shorter, with more broadly spreading zygomata (outer sides nearly parallel).

Measurements.—Average of 6 males from type locality: total length 267 mm.; tail vertebræ 137; hind foot 33.

ORYZOMYS AQUATICUS Allen.

Oryzomys aquaticus ALLEN, Bull. Am. Mus. Nat. Hist., New York, III, 289, June, 1891.

Type locality.—Brownsville, Texas.

Characters.—Size large; ears small; color light fulvous; belly yellowish fulvous.

Color.—Upperparts yellowish or buffy fulvous, moderately lined with black hairs; underparts buffy yellow or buffy fulvous; ears brown, only slightly darkened toward margins; tail brown above, yellowish below.

Cranial characters.—Skull large and heavy, with marked superciliary beads which in old skulls extend posteriorly over sides of braincase and are *strongly incurved* before reaching occiput.

Remarks.—The only species resembling *aquaticus* externally is *albiventer*, which may be distinguished at a glance by its white belly.

Measurements.—Average of 4 adults from type locality: total length 288 mm.; tail vertebræ 149; hind foot 32.5.

ORYZOMYS PENINSULÆ Thomas.

Oryzomys peninsula THOMAS, Ann. & Mag. Nat. Hist., 6th Ser., xx, pp. 548–549, Dec., 1897.

Type locality.—Santa Anita, Peninsula of Lower California, Mexico.

Characters.—Size rather large; ears rather small; tail short; color grayish; belly whitish; skull broad and massive.

Color.—Upperparts grayish brown, becoming pale fulvous on rump; back only moderately mixed with black hairs; underparts soiled white, the slaty basal fur showing through; feet whitish; tail dusky or brownish above, soiled whitish below.

Cranial characters.—Skull broad and massive with broadly and rather squarely spreading zygomata; slender tapering nasals; long premaxillæ reaching far behind nasals; slight superciliary beads; large and broadly open palatal slits, and rather large molars. The skull is so unlike any known species that no comparisons are necessary. It is about the size of *mexicanus* but has a widely different aspect owing to the broadly and squarely spreading zygomata. The frontal region is lower and narrower than in *mexicanus*, nasals more slender, premaxillæ longer, incisive foramina larger; molars about the same size.

Measurements.—Topotype (♀ ad): total length 257 mm.; tail vertebræ 138; hind foot 33.

ORYZOMYS NELSONI Merriam.

Oryzomys nelsoni MERRIAM, Proc. Biol. Soc. Washington, Vol. XII, p. 15, January 27, 1898.

Type locality.—Maria Madre, Tres Marias Ids., Mexico.

Characters.—Size very large; ears medium or rather small; hind feet and tail long; color pale fulvous; skull unique: large, massive; with greatly swollen and strongly decurved rostrum.

Color.—Upperparts ochraceous or buffy fulvous, most intense on rump, becoming buffy grayish anteriorly, especially on face; underparts white, the slaty underfur showing through; tail brown, paler below. Ears brown; feet whitish.

Cranial characters.—Skull large, massive, somewhat flattened above, with strongly marked and nearly straight superciliary beads, rather heavy zygomata, bowed outward in middle; acute decurved nasals, ending essentially on plane of premaxillæ; *enormously swollen and strongly decurved rostrum*; moderate palatal slits; rather large molars (not large for size of skull), and large, broad, and shortly curved upper incisors.

Measurements.—Average of 2 adult males from type locality: total length 343 mm.; tail vertebræ 190; hind foot 38.5. An adult female: total length 320; tail vertebræ 185; hind foot 37.

ORYZOMYS ALBIVENTER sp. nov.

Type from Ameca, Jalisco, Mexico. No. 82236 ♂ ad. U. S. National Museum, Biological Survey Coll. February 6, 1897. E. W. Nelson and E. A. Goldman. Original number 10478.

Characters.—Size large; ears short; color light golden fulvous; *underparts white*. Skull and teeth large and heavy.

Color.—Upperparts bright ochraceous, brightest on rump, more grayish anteriorly; back strongly lined with black hairs; underparts clear white without buffy or salmon suffusion; tail bicolor, dusky above, whitish below.

Cranial characters.—Skull large and heavy; zygomata rather broadly spreading; nasals large and broad, slightly exceeding premaxillæ; superciliary ridges well developed, nearly straight; incisive foramina long, but not so broadly open as in *crinitus*; molars larger and heavier than in any other known species, the series measuring over 5 mm.

Remarks.—The only near relative of *albiventer* seems to be *aquaticus* from the lower Rio Grande region in Texas. Externally it resembles *aquaticus* closely as seen from above, although the rump is more intense fulvous, but the underparts are white, while in *aquaticus* they are buffy fulvous. The skull differs from *aquaticus* in having much less pronounced superciliary beads, less marked orbital angle of frontal [frontals less swollen anteriorly]; larger incisive foramina, and decidedly larger molars.

Measurements.—Type specimen (♂ ad.): total length 288 mm.; tail vertebræ 153; hind foot 37.5. Average of 7 adult males from type locality: total length 295; tail vertebræ 162; hind foot 37.3. Average of 2 adult females from type locality: total length 287; tail 155; hind foot 33.7.

ORYZOMYS COZUMELÆ sp. nov.

Type from Cozumel Island, Yucatan, Mexico. No. 108462 ♂ ad. U. S. National Museum, Biological Survey Coll. April 8, 1901. E. W. Nelson and E. A. Goldman. Original number 14666.

Characters.—Size large; similar to *O. aquaticus*, but darker; ears and hind feet larger; tail much longer and much darker.

Color.—Upperparts dark grayish bister with pale fulvous suffusion on sides and rump; in old pelage back (especially rump) rusty red; underparts varying from soiled whitish to pale buffy salmon; ears dark brown, darkest on outer half; tail dusky, paler below.

Cranial characters.—Skull large and heavy, with strongly marked superciliary beads, long rostrum, and long incisive foramina. Closely related to *aquaticus*, from which it differs in the following characters: anterior roots of zygomatics more depressed and less spreading; orbital angle of frontal less marked; posterior part of braincase broader, carrying the lateral beads *outward posteriorly*, so that they form almost a straight line from side of occiput to angle of orbit; incisive foramina longer and more open.

Remarks.—Compared with *aquaticus*, the only species to which it bears any near resemblance, the color in fresh pelage is grayer and darker (less golden fulvous); in worn pelage redder—the rump and hinder part of back more rusty; ears and face darker, the face strongly grizzled with black hairs. The underparts are never buffy yellow as in *aquaticus*.

Measurements.—Type specimen (♂ ad.): total length 332 mm.; tail vertebræ 182; hind foot 35. Average of 5 adults from type locality: total length 315; tail vertebræ 176; hind foot 34.5.

ORYZOMYS FULGENS Thomas.

Oryzomys fulgens THOMAS, Ann. & Mag. Nat. Hist. (6), XI, 403-404, May, 1893.

Type locality.—Mexico, exact locality unknown. Collected by A. Boucard in southern Mexico, probably in or near the Valley of Mexico.

Characters.—"Size large. Fur very thick, coarse and wooly. General colour above bright fulvous, brighter than in any other Central-American species; anterior half of the body, including the head, rather paler and duller than the posterior half. Ears decidedly small, broadly rounded, thinly hairy, their hairs practically the same colour as those of the head in general, so that they are not distinguishable by colour at a distance. Lips, chin, throat and inguinal region whitish, belly with a strong suffusion of fawn, which reaches a maximum on the breast between the forelegs, passage of upper colour into lower quite gradual. Outer sides of limbs like back, inner sides whitish; upper surfaces of hands and feet thinly clothed with pale silvery-fawn hairs. Tail long, thinly haired, the scales not hidden by the hairs; above blackish, below yellowish, darkening towards the tip."

Cranial characters.—"Skull readily distinguishable from all allied species by its great breadth, the bold expansion of the zygomata, and especially by the evenly incurved outline of the supraorbital edges; in all other species these edges form two approximately straight lines diverging from the narrowest interorbital point, but in *O. fulgens* the whole inner wall of the orbit forms one even curve, the breadth at the posterior end of the olfactory chamber being scarcely greater than at the anterior end. Nasals broad and flattened. Frontal premaxillary processes very narrow and barely attaining to the same level as the back of the nasals. Anterior palatine foramina large, widely open, their posterior margin just level with the front of *m*¹."

Remarks.—In the absence of an authentic specimen of this species I have been obliged to quote Thomas' original description as above. Since it was written, several species have been discovered which share part of the characters mentioned.

Measurements.—Type specimen (male adult) measured from the skin by Thomas: head and body 160 mm.; tail 151; hind foot 37.5; ear from notch 13.3.

ORYZOMYS CRINITUS sp. nov.

Type.—from Tlalpam, Federal District, Mexico. No. 50182 ♂ ad. U. S. National Museum, Biological Survey Coll. Nov. 30, 1892. E. W. Nelson and E. A. Goldman. Original number 3905.

Characters.—Size large, pelage long, full and soft; hind feet long and large; tail bicolor; ears rather short.

Color.—Upperparts buffy fulvous, most intense on rump; back copiously lined with and obscured by black hairs; underparts buffy (except on chin, throat, and forelegs, which are whitish); tail dusky above, yellowish below.

Cranial characters.—Skull large and broad; anterior roots of zygomata spreading, the outer sides as seen from above more nearly parallel than usual (instead of strongly approximating anteriorly), but dipping down below level of posterior root; nasals broad and blunt posteriorly; superciliary beads moderate; incisive foramina very large and broadly open; molars large (series 5 mm.). The skull is very close to that of *aztecus* from Yautepec, Morelos, from which it differs in slightly larger and higher braincase, heavier zygomata, slightly larger bullæ, palatal slits larger and more broadly open (posteriorly); nasals broader posteriorly; premaxillæ slightly shorter; molars broader anteriorly.

Remarks.—This strongly marked species appears to be closely related to *O. fulgens* of Thomas, the type locality of which unfortunately is unknown. Externally it differs from *fulgens*, as described by Thomas, in being much less bright fulvous. Thomas states that *fulgens* is brighter than any of the species known to him, and in the same paper describes *O. melanotis*, which is very much more highly colored than *crinitus*. The skull of *crinitus* (♂ ad.) is about 2 mm. shorter than Thomas' measurements of the type of *fulgens*; it is also narrower across the zygomata and has shorter nasals. It is not unlikely that *crinitus* will prove only a subspecies of *fulgens*. Crani-ally it is related to *aztecus*, as shown above, but externally the resemblance is less close. It is larger than *aztecus*, has smaller ears, larger feet, longer tail, longer and softer pelage, and the belly is buffy-fulvous instead of white.

Measurements.—Type specimen (♂ ad.): total length 307 mm.; tail vertebræ 161; hind foot 37.

ORYZOMYS CRINITUS AZTECUS subsp. nov.

Type from Yautepec, Morelos, Mexico. No. 51173 ♂ ad. U. S. National Museum, Biological Survey Coll. Jan. 16, 1893. E. W. Nelson and E. A. Goldman. Original number 4290.

Characters.—Closely related to *crinitus*, from which it differs in slightly smaller size and paler coloration; sides and rump pale buffy fulvous; underparts *white* instead buffy fulvous. Old specimens in worn pelage resemble *albiventer*.

Color.—Upperparts buffy fulvous or ochraceous, redder in old pelage, moderately lined with black hairs; underparts white; tail brownish above, paler below.

Cranial characters.—Skull similar to that of *crinitus* but nasals and zygomata more slender; bullæ smaller; incisive foramina not quite so large.

Measurements.—Type specimen (♂ ad.): total length 290 mm.; tail vertebræ 154; hind foot 35.

Remarks.—A specimen from Tehuantepec (No. 73407 ♂) agrees externally with an old specimen from Piaxtla, Puebla, and in cranial characters agrees in the main with *aztecus*, having the same downward bowed zygomata and so on, but differs in having the palatal slits more broadly open posteriorly.

ORYZOMYS MEXICANUS Allen.

Oryzomys mexicanus ALLEN, Bull. Am. Mus. Nat. Hist., IX, pp. 52-53, March 15, 1897.

Type from Hacienda San Marcos, Tonila, Jalisco, Mexico.

Characters.—Size medium; hind feet large; ears rather small (smaller than in *jalapæ*); color grizzled fulvous brown; underparts white or buffy; skull massive.

Color.—Upperparts ochraceous or pale fulvous, deepest on rump, strongly lined with black hairs; underparts white, the belly sometimes suffused with buffy; ears not conspicuously darker than surrounding parts; tail dark brown or dusky, paler below.

Cranial characters.—Skull broad and massive, with strong zygomata, well defined superciliary ridges, long palatine slits, and rather heavy molars. Compared with *jalapæ* the skull is broader and more massive, the zygomata much heavier, especially anteriorly; superciliary beads more pronounced; molars heavier.

Measurements.—Average of 2 specimens from Armeria, Colima: total length 275 mm.; tail vertebræ 139; hind foot 33.

Remarks.—*Oryzomys mexicanus* has a wide range in western Mexico. The Biological Survey Collection contains specimens collected by Nelson and Goldman from Rosario in southern Sinaloa, across the states of Tepic, Jalisco, Colima, Guerrero, and Oaxaca, to the isthmus of Tehuantepec.

ORYZOMYS MEXICANUS PERAGRUS subsp. nov.

Type from Rio Verde, San Luis Potosi, Mexico. No. 82111 ♂ yg.-ad. U. S. National Museum, Biological Survey Coll. January 8, 1897. E. W. Nelson and E. A. Goldman. Original number 10398.

Characters.—Similar to *mexicanus* but tail decidedly longer and rather sharply bicolor; color very much grayer (less fulvous); back more copiously and evenly mixed with black hairs; underparts deeper buffy-fulvous; ears darker; ascending arms of premaxillæ a little heavier posteriorly; bullæ larger; incisive foramina larger; molars larger and heavier.

Remarks.—Externally *peragrus* resembles *jalapæ* more closely than it does *mexicanus*, but the skull is nearer *mexicanus*, being larger and broader than *jalapæ*, with heavier zygomata and much more pronounced superciliary ridges. The bullæ and molars are decidedly larger than in *mexicanus*.

Measurements.—Type specimen (♂ yg.-ad.): total length 294 mm.; tail vertebræ 167; hind foot 35.

ORYZOMYS RICHMONDI sp. nov.

Type from Escondido River (50 miles above Bluefields), Nicaragua. No. $\frac{36349}{48703}$ ♂ ad. U. S. National Museum, Biological Survey Coll. June 21, 1892. Chas. W. Richmond. Original number 63.

General characters.—Size rather large; ears rather short; pelage rather coarse; color grizzled fulvous. Animal closely related to *mexicanus*, but much darker.

Color.—Upperparts grizzled yellowish fulvous, everywhere (but especially on top of head) conspicuously lined and darkened by coarse black hairs; black hairs least abundant on rump which in some specimens (as in the type) is intense fulvous or even rusty; underparts ochraceous fulvous, chin and lips paler; tail dark, paler below but not distinctly bicolor.

Cranial characters.—Skull rather large and heavy with well marked superciliary beads, moderately spreading zygomata, and rather long and relatively slender rostrum. Compared with *mexicanus*, with which the skull agrees in size, the rostrum averages decidedly longer and more slender, with longer nasals (which usually end behind premaxillæ).

Measurements.—Type specimen (♂ ad.): total length 295; tail vertebræ 150; hind foot 33.5. Average of 10 ♂'s from type locality: total length 275; tail vertebræ 137; hind foot 31.3.

ORYZOMYS JALAPÆ Allen.

Oryzomys jalapæ ALLEN, Bull. Am. Mus. Nat. Hist. New York, IX, 206-207, June 16, 1897.

Type from Jalapa, Vera Cruz, Mexico.

Characters.—Size medium, about equalling *mexicanus*; hind foot smaller than in *mexicanus*; ears larger and darker; general color grizzled buffy fulvous; skull rather slender.

Color.—Upperparts buffy fulvous or ochraceous, conspicuously lined with black hairs; underparts strongly ochraceous except chin and throat, which are whitish; ears and upper side of tail dusky, underside of tail yellowish.

Cranial characters.—Skull similar in general to that of *mexicanus* but narrower and lighter, with much slenderer zygomata and less distinct superciliary beads; molars decidedly smaller.

Remarks.—Externally *jalapæ* resembles *mexicanus* rather closely in size and color, but it is easily distinguished by its much larger ears and smaller hind feet, and also by the strong fulvous underparts, the underparts in *mexicanus* being white or buffy. The cranial differences have been already pointed out. *O. jalapæ* is common in most parts of the State of Vera Cruz and in parts of northwestern Puebla.

Measurements.—Average of 6 specimens from Orizaba, Oaxaca: total length 266 mm.; tail vertebræ 140.5; hind foot 31.

ORYZOMYS JALAPÆ RUFINUS subsp. nov.

Type from Catemaco, Vera Cruz, Mexico. No. 65499 ♀ ad. U. S. National Museum, Biological Survey Coll. April 27, 1894. E. W. Nelson and E. A. Goldman. Original number 6112.

Characters.—Similar to *jalapæ* but back, and especially *rump*, much redder, the color intense fulvous; *tail dusky all round*, the underside even to very base being dark, and the white hairs smaller and less abundant; incisors heavier than in *jalapæ*; molars in female (type specimen) as large as in the largest male of *jalapæ*.

Measurements.—Type specimen (♀ ad.): total length 270 mm.; tail 139; hind foot 32.

ORYZOMYS ZYGOMATICUS sp. nov.

Type from Nenton, Guatemala. No. 76794 ♂ ad. U. S. National Museum, Biological Survey Coll. Dec. 15, 1895. E. W. Nelson and E. A. Goldman. Original number 8798.

Characters.—Size and ears medium; color dull fulvous; size and external appearance much as in *jalapæ* but hind feet larger; ears slightly smaller; underparts much paler; skull characters distinctive.

Color.—Upperparts dull pale fulvous, conspicuously lined on middle of back with black hairs; underparts in type specimen white with slight buffy suffusion, strongest between forelegs; in younger specimens suffusion deeper.

Cranial characters.—Skull similar in size and general form to *jalapæ*, but superciliary ridges *much more strongly developed and everted*; nasals narrower on middle and posterior thirds; *zygomata strongly and evenly bowed outward and downward*, sinking far below level of posterior root—instead of approximating and sloping forward and upward from posterior root as usual.

Remarks.—Externally this species resembles *mexicanus* as closely (perhaps more closely) than it does *jalapæ*, and its relationship to *mexicanus* appears to be close. But the skull differs from that of *mexicanus* in the curious form of the zygomata, which are strongly bowed outward and downward; in the narrower nasals, narrower rostrum, smaller braincase, and slightly smaller molars. In the form of the zygomata and some other respects it suggests *aztecus*.

Measurements.—Type specimen (♂ ad.): total length 290 mm.: tail 152; hind foot 33.

ORYZOMYS TEAPENSIS sp. nov.

Type from Teapa, Tabasco, Mexico. No. 99973 ♂ yg.-ad. U. S. National Museum, Biological Survey Coll. April 4, 1900. E. W. Nelson and E. A. Goldman. Original number 14100.

Characters.—Similar in general to *O. jalapæ* but ears decidedly smaller; hind feet (and tail?) shorter; pelage shorter and coarser; color much darker; rostrum much smaller.

Color.—Upperparts very dark grizzled bister, becoming yellowish on sides, and profusely mixed with black hairs; underparts, except chin, throat and forelegs, suffused with buffy fulvous; tail dusky, becoming yellowish at base below.

Cranial characters.—Skull small, with poorly developed superciliary beads, and *small decurved rostrum*; incisive foramina broadly open behind premaxillary sutures. It differs markedly from *jalapæ* in the small rostrum and broadly open (posteriorly) incisive foramina.

Measurements.—Type specimen (♂ yg.-ad.): total length 259 mm.; tail 129; hind foot 32.5.

ORYZOMYS BULLERI Allen.

Oryzomys bulleri ALLEN, Bull. Am. Mus. Nat. Hist., IX, 53-54, March 15, 1897.

Type from Valle de Banderas, Jalisco, Mexico.

Characters.—Size medium or rather small; ears rather small; color buffy fulvous.

Color.—Upperparts buffy fulvous, deepest on rump, palest anteriorly, lined on back with black hairs; underparts white; nose dusky; tail brownish above, yellowish below.

Cranial characters.—Skull similar to that of *jalapæ* but slightly smaller, with smaller rostrum, more acute nasals, vanishing superciliary beads, and slightly longer molar series.

Remarks.—*Oryzomys bulleri* is most nearly related to *jalapæ*, but externally it resembles *mexicanus* most closely. In fact, judged from the skin alone, it is merely a small edition of *mexicanus*—slightly paler above, white bellied, and with very much smaller feet. But its light and delicate skull requires no comparison with the larger and more massive skull of *mexicanus*.

Measurements.—Average of 6 specimens from Armeria, Colima: total length 251 mm.; tail vertebræ 134; hind foot 31.

ORYZOMYS RUFUS sp. nov.

Type from Santiago, Tepic, Mexico. No. 91404 ♀ old. U. S. National Museum, Biological Survey Coll. June 20, 1897. E. W. Nelson and E. A. Goldman. Original number 11232.

Characters.—Similar in general to *bulleri* but smaller and redder; pelage softer; skull very short; ears rather small.

Color.—Upperparts deep dull fulvous, the fulvous reaching forward to head and not obscured on back by black hairs (the black hairs small and scattering); underparts soiled white, the plumbous underfur showing through except on chin and in inguinal region; tail dusky, paler below.

Cranial characters.—Skull short and heavy; superciliary bead only slightly developed; incisive foramina remarkably long; rostrum small and short. Compared with *bulleri* the skull is decidedly shorter and more massive; superciliary ridges slightly more pronounced; rostrum much smaller and shorter; zygomata more spreading and more strongly elbowed anteriorly; palatine slits very much longer and larger; teeth smaller.

Measurements.—Type specimen (♀ old): total length 250 mm.; tail 136; hind foot 28.

ORYZOMYS COUESI (Alston).

Hesperomys couesi ALSTON, Proc. Zool. Soc. London, p. 756, 1876.

Oryzomys couesi THOMAS, Ann. and Mag. Nat. Hist. (6), Vol. XL, p. 403, May, 1893.

Type locality.—Coban, Guatemala.

Characters.—Size and ears medium; pelage harsh; fulvous brown; skull light and thin (apparently intermediate between the *jalapæ* and *chapmani* groups); molar series very long.

Color.—Upperparts varying from buffy fulvous to deep fulvous, conspicuously grizzled with black hairs; underparts varying from yellowish fulvous to salmon fulvous; ears and upper side of tail dusky; tail below whitish; hind feet whitish.

Cranial characters.—Skull thin, light, rather long and narrow, with slender zygomata and faint superciliary beads; incisive foramina very long and open (remarkably large for size of skull); molar series long (5 mm.) but not massive.

Remarks.—The above description is based on specimens from Tumbala, Chiapas, which are believed to be fairly typical of the species as redefined and restricted by Thomas (Ann. and Mag. Nat. Hist., 6 ser., vol. XL, no. 65, p. 403, May, 1893).

The species is very distinct, and appears to have no near relative. Compared with *jalapæ*, which it most resembles externally, it differs materially in cranial characters. The skull is lighter, the rostrum smaller, zygomata more slender, superciliary beads more nearly obsolete, palatal slits much longer and more open; molar series decidedly longer. Compared with *bulleri*, to which it bears less resemblance externally, the cranial characters are closer. The skull agrees with *bulleri* in size and general characters, but is somewhat lighter and has larger palatal slits and longer molar series.

Measurements.—Average of 5 specimens from Tumbala, Chiapas: total length 252 mm.; tail vertebræ 131; hind foot 30.5.

ORYZOMYS GOLDMANI sp. nov.

Type from Coatzacoalcos, Vera Cruz, Mexico. No. 78110 ♀ ad. U. S. National Museum, Biological Survey Coll. April 11, 1896. E. W. Nelson and E. A. Goldman. Original number 9511.

Characters.—Size small; ears rather large; tail long; color dull fulvous brown; skull narrow, smoothly rounded, with faint trace of superciliary bead.

Color.—Upperparts finely mixed fulvous and black, the black hairs very abundant; underparts soiled buffy (in one specimen almost salmon); tail dusky above, pale below.

Cranial characters.—Skull small and light, narrow, smoothly rounded, with hardly a trace of superciliary bead; nasals broad, slightly exceeding premaxillæ; incisive foramina rather long; bullæ rather large and more globular than usual; molars large and broad (disproportionally large for size of skull), equalling those of the much larger *jalapæ*.

Remarks.—This species differs so widely from its allies that close comparison is unnecessary. Its nearest known relative appears to be *couesi* from Coban, Guatemala, from which it differs not only in much smaller size (both externally and cranially), but also in possessing equally large and heavier (broader) molar teeth. In some respects it

seems to be intermediate between the smaller *chapmani* group and the larger *jalapæ* group, with *bulleri* as the nearest relative in the direction of *jalapæ*. But the gaps in both directions are wide.

Measurements.—Type specimen (♀ ad.): total length 233 mm.; tail vertebræ 124; hind foot 30.

ORYZOMYS CHAPMANI Thomas.

Oryzomys chapmani THOMAS, Ann. & Mag. Nat. Hist., 7th ser., I, 179–180, February 1, 1898.

Type locality.—Jalapa, Vera Cruz, Mexico.

Characters.—Size small; pelage short or rather coarse; coloration dark; ears rather large and dark; tail small and slender; skull small, smooth and mouselike.

Color.—Upperparts finely grizzled fulvous and black, the black hairs most numerous on top of head and middle of back; underparts whitish, the slaty underfur showing through; ears and tail blackish; under side of tail yellowish, except on terminal part, which is dark all around.

Cranial characters.—Skull resembling that of an ordinary white-footed mouse, *Peromyscus*; small, light, smoothly rounded, without conspicuous superciliary beads; zygomata rather strongly spreading anteriorly, the outer sides nearly parallel but slightly nearer together anteriorly than posteriorly; rostrum rather long; nasals blunt posteriorly, ending about on a plane with premaxillæ; incisive foramina rather small.

Measurements.—[From Chapman] Average of 11 males from type locality: total length 222 mm.; tail vertebræ 119; hind foot 25.2. Average of 5 females from type locality: total length 219; tail vertebræ 116; hind foot 24.6.

Average of 2 adults (♂ and ♀) from Jico, Vera Cruz [measured by Nelson and Goldman]: total length 224; tail vertebræ 117.5; hind foot 26.

ORYZOMYS CHAPMANI CAUDATUS subsp. nov.

Type from Comaltepec, Oaxaca, Mexico. No. 68641 ♂ ad. U. S. National Museum, Biological Survey Coll. July 31, 1894. E. W. Nelson and E. A. Goldman. Original number 6516.

Characters.—Similar to *chapmani* but larger, tail much longer: color slightly darker; skull larger and heavier with larger rostrum and broader nasals.

Measurements.—Type specimen (♂ ad.): total length 257 mm.; tail vertebræ 141; hind foot 30.

Proc. Wash. Acad. Sci., July, 1901.

ORYZOMYS CHAPMANI SATURATIOR subsp. nov.

Type from Tumbala, Chiapas. No. 76183 ♀ ad. U. S. National Museum, Biological Survey Coll. October 23, 1895. E. W. Nelson and E. A. Goldman. Original number 8574

Characters.—Similar to *chapmani* but decidedly darker, particularly on top of head and middle of back, which are blackish, slightly 'peppered' with fine points of fulvous; underparts soiled buffy, in some specimens salmon; cheeks fulvous; ears, hind feet, and tail blackish.

Measurements.—Type specimen (♀ ad.): total length 218 mm.; tail vertebrae 120; hind foot 25.5.

ORYZOMYS CHAPMANI DILUTIOR subsp. nov.

Type from Huauchinango, Puebla, Mexico. No. 93124 ♂ ad. U. S. National Museum, Biological Survey Coll. January 10, 1898. E. W. Nelson and E. A. Goldman. Original number 12040.

Characters.—Similar to *chapmani* but slightly paler; hind foot longer; rostrum and nasals broader; rostrum more swollen at base; anterior root of zygoma heavier.

Measurements.—Type specimen (♂ ad.): total length 223 mm.; tail vertebrae 117; hind foot 28.

ORYZOMYS PALATINUS sp. nov.

Type from Teapa, Tabasco, Mexico. No. 99977 ♀ ad. U. S. National Museum, Biological Survey Coll. April 1, 1900. E. W. Nelson and E. A. Goldman. Original number 14080.

Characters.—Size small; color dark with intense red-fulvous suffusion. Similar to *chapmani* but back redder; cranial characters distinctive.

Color.—General effect of upperparts nearly burnt umber, from fine admixture of intense rufous and black hairs; sides, to and including cheeks, pale fulvous; underparts whitish, the slaty underfur showing through; hind feet whitish; ears and tail dark, the tail paler underneath basally.

Cranial characters.—Skull small, light, and slender, with only faintest trace of supraorbital bead; zygomata narrow, their outer sides parallel; incisive foramina short, broadly spreading posteriorly and separated by a very broad septum.

Remarks.—Compared with *chapmani*, its only known near relative, the general color is redder; the cheeks decidedly more fulvous; the

skull narrower, with narrower parallel zygomata, smaller bullæ, and widely different incisive foramina, as above described.

Measurements.—Type specimen (♀ ad.): total length 209 mm.; tail vertebræ 106; hind foot 25.

ORYZOMYS HYLOCETES sp. nov.

Type from Chicharras, Chiapas, Mexico. No. 77605 ♂ old. U. S. National Museum, Biological Survey Coll. Feb. 14, 1896. E. W. Nelson and E. A. Goldman. Original number 9306.

Characters.—Size small; ears large; color dark with ruddy suffusion. Similar to *palatinus* from Teapa but skull different.

Color.—Upperparts very dark rufous brown; underparts soiled whitish, the dark slate basal fur showing through; hind feet dark; ears and tail blackish.

Cranial characters.—Skull small, light, and narrow, with spreading zygomata, and flat nasals which are *shortly truncate anteriorly*. Similar in size and general characters to *chapmani* and *palatinus*, with braincase narrow as in *palatinus*, but zygomata more spreading than either, and nasals peculiar, being rather flat and shortly and squarely truncate anteriorly.

Measurements.—Type specimen (♂ ad.): total length 217 mm.; tail vertebræ 118; hind foot 27.

ORYZOMYS RHABDOPS sp. nov.

Type from Calel, Guatemala (alt. 10000 ft.). No. 76813 ♂ ad. U. S. National Museum, Biological Survey Coll. Jan. 15, 1896. E. Nelson and E. A. Goldman. Original number 9135.

Characters.—Size medium; ears thin, rather large; nose and *streak from nose to eye black*; pelage long and woolly; color dark grizzled fulvous; underparts soiled white. Skull with broadly spreading squarish zygomata and short incisive foramina.

Color.—Upperparts fulvous, on head and back grizzled and obscured by black hairs, on sides purer and reaching forward to cheeks; underparts soiled whitish; nose and streak from nose to eye blackish; sides of nose below black streak pale fulvous; ears blackish; tail dusky brown above, yellowish below. The young are darker and resemble *angusticeps*.

Cranial characters.—Braincase large and rounded; rostrum long and slender; zygomata very broadly and squarely spreading, their anterior roots in adults reaching far outward, their outer sides parallel or even slightly broadest anteriorly (in this respect unlike any other known species); incisive foramina short and rather broad.

Remarks.—This very distinct species and its narrow skulled, small toothed relative, *angusticeps*, belong to the *chapmani-hylocetes* group, of which they are high mountain representatives. They differ from the other members of the group in having long woolly coats and distinct face markings.

A specimen from Pinabete, Chiapas (♂ yg.-ad. No. 77604), is darker than adults of *rhabdops* and has shorter rostrum and nasals, and less spreading zygomata. A series from San Cristobal, Chiapas (all immature), are in the darker pelage of the young *rhabdops*. They have long rostrums and narrow zygomata but are too young to warrant separation.

Measurements.—Type specimen (♂ ad.): total length 255 mm.; tail vertebræ 141; hind foot 29.5. Average of 3 adults from type locality: total length 250; tail vertebræ 136; hind foot 29.

ORYZOMYS ANGUSTICEPS sp. nov.

Type from Volcan Santa Maria, Guatemala (alt. 9000 ft.). No. 76816 ♂ ad. U. S. National Museum, Biological Survey Coll. Jan. 22, 1896. E. W. Nelson and E. A. Goldman. Original number 9190.

Characters.—Size medium, ears large; color very dark fulvous brown. Externally similar to *rhabdops* from the high mountains at Cabel, Guatemala, but ears larger, color decidedly darker (upperparts more finely mixed fulvous and black); cranial characters distinctive.

Color.—Upperparts and sides (encroaching on sides of belly) finely mixed dark fulvous and black, the black hairs most numerous on top of head and middle strip of back, but not forming a defined darker area; underparts narrowly buffy, the dark slate underfur showing through; ears and upper side of tail blackish; underside of tail paler on basal half.

Cranial characters.—Skull light and smoothly rounded, long and narrow throughout (including braincase, zygomata, and rostrum); nasals very long; supraorbital beads obsolete, incisive foramina rather large for the group, broadest in middle; teeth small and light.

Measurements.—Type specimen (♂ ad.): total length 245 mm.; tail vertebræ 134; hind foot 29.

ORYZOMYS MELANOTIS Thomas.

Oryzomys melanotis THOMAS, Ann. & Mag. Nat. Hist., 6th ser., XI, 404-405, May, 1893.

Type locality.—San Sebastian, Jalisco, Mexico.

Characters.—Size medium; ears large and dark; color orange fulvous; underparts whitish.

Color.—Upperparts bright intense ochraceous fulvous, moderately lined with black hairs; underparts buffy whitish, the slaty underfur showing through; tail dusky above, yellowish below.

Cranial characters.—Skull of medium size and strength; zygomata moderately spreading; superciliary beads only slightly developed; rostrum rather long and straight (not decurved); nasals rather broadly (but not squarely) truncate posteriorly; incisive foramina rather short and broadly open posteriorly—differing markedly from the long slender slits of the *mexicanus* group.

Measurements.—Average of 5 from type locality: total length 235 mm.; tail vertebræ 128; hind foot 28.2.

ORYZOMYS ROSTRATUS sp. nov.

Type from Metlaltoyuca, Puebla, Mexico. No. 93112 ♂ old. U. S. National Museum, Biological Survey Coll. Feb. 5, 1898. E. W. Nelson and E. A. Goldman. Original number 12130.

Characters.—Size medium or rather large; ears large. Similar to *melanotis* but larger; pelage coarser (but less harsh than in subspecies *megadon* from the coast region of Tabasco and Campeche); cranial characters distinctive.

Color.—Upperparts ochraceous fulvous abundantly lined with black hairs; underparts buffy white, the slaty basal fur showing through; ears and tail dark brown; underside of tail irregularly yellowish.

Cranial characters.—Skull large, rather massive, long and flattened; rostrum long and somewhat swollen basally by projecting anterior lip of antorbital vacuity; nasals large, broad, and flat, ending about on plane with premaxillæ; superciliary beads moderate; zygomata rather narrow anteriorly and posteriorly but bowed out in middle; zygomatic or outer lip of antorbital vacuity strongly produced; incisive foramina medium. Compared with *melanotis* the skull is larger; rostrum much longer and more swollen; nasals less squarely truncate posteriorly; zygomata bowed strongly outward, widest a little behind middle.

Remarks.—*Oryzomys melanotis* is a West Coast species (type from San Sebastian, Jalisco). Its representatives on the East Coast are slightly larger, with coarser pelage, larger, flatter and more angular skulls, with decidedly larger rostrum. They range on the east from Alta Mira, Tamaulipas, southerly and easterly to Apazote, Campeche, and perhaps to Yucatan. The southern form (subspecies *megadon*, from Tabasco and Campeche) is redder in color, the pelage is more hispid, and the molar teeth are heavier than in the northern form.

Specimens of the northern form from Alta Mira have smaller rostrum and nasals and are not typical.

Measurements.—Type specimen (δ old): total length 277 mm.; tail vertebrae 141; hind foot 32.5. Average of 10 from type locality: total length 251; tail vertebrae 135; hind foot 32. The average of 5 topotypes (all young adults) of *melanotis* is: total length 235; tail vertebrae 128; hind foot 28.2.

ORYZOMYS ROSTRATUS MEGADON subsp. nov.

Type.—From Teapa, Tabasco, Mexico. No. 99978 δ old. U. S. National Museum, Biological Survey Coll. March 24, 1900. E. W. Nelson and E. A. Goldman. Original number 14062.

Characters.—Similar to *rostratus* but somewhat smaller; pelage more hispid; color decidedly redder; skull smaller with narrower rostrum; molars larger and heavier. Also similar to *melanotis*, but hind foot larger; pelage harsher; color redder [averaging warm intense fulvous instead of yellowish or golden fulvous]; darker from more bountiful admixture of black hairs; rostrum and nasals longer and larger; nasals less squarely truncate posteriorly; molars heavier (broader).

Remarks.—In ranging westward this animal undoubtedly grades into *rostratus*, the type locality of which is Metlatoyuca, Puebla.

Measurements.—Type specimen (δ ad.): total length 272 mm.; tail vertebrae 140; hind foot 32.5. A topotype female measures: total length 237; tail vertebrae 122; hind foot 31.

ORYZOMYS YUCATANENSIS sp. nov.

Type from Chichenitza, Yucatan, Mexico. No. 108139 δ yg.-ad. U. S. National Museum, Biological Survey Coll. Feb. 9, 1901. E. W. Nelson and E. A. Goldman. Original number 14527.

Characters.—Very similar to *melanotis* but fulvous more extended anteriorly, covering sides of face to nose [*melanotis* has a whitish cheek patch between eye and mouth]; ears fulvous brown instead of blackish [blackish in young]; underparts white; underside of tail yellowish throughout; head and back moderately lined with black hairs.

Cranial characters.—Skull rather small, with distinct superciliary beads, short incisive foramina, and *very small molars*. Contrasted with *melanotis* the skull is smaller (?), superciliary bead more prominent; nasals less squarely truncate posteriorly; incisive foramina shorter; molars smaller.

Measurements.—Type specimen (♂ yg.-ad.): total length 235 mm.; tail 119; hind foot 32.

ORYZOMYS FULVESCENS (DeSaussure).

Hesperomys fulvescens DESAUSSURE, Rev. et Mag. Zool., xii, pp. 102-103, March, 1860.

Oryzomys fulvescens ALLEN, Bull. Am. Mus. Nat. Hist., N. Y., ix, p. 204, June, 1897.

Type locality.—Unknown. Collected by Sumichrast, probably in the vicinity of Orizaba, Vera Cruz, which is here fixed as the type locality.

Characters.—Size smallest of the known species, with much the appearance of the smaller species of *Reithrodontomys*; color, including underparts, yellowish fulvous; skull small, thin, and papery, about the size of that of the common house mouse, and suggesting the smallest species of *Reithrodontomys*.

Color.—Upperparts yellowish fulvous, copiously lined with black hairs; underparts bright and rather intense yellowish fulvous; chin and throat paler. In immature specimens the belly is sometimes whitish.

Cranial characters.—Skull small and thin, without trace of supra-orbital bead; braincase swollen and smoothly rounded; zygomata slender, almost threadlike, weak anteriorly; incisive foramina short and broadly open; nasals rather small, ending about on plane with premaxillæ.

Remarks.—This tiny species has a very extensive distribution, ranging over considerable parts of Vera Cruz, Oaxaca, Guerrero, Chiapas, Yucatan, and Guatemala.

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PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXIV.

THE WILLOWS OF ALASKA.

[PLATES XXXIII-XLII. TEXT FIGURES 17-28.]

BY FREDERICK V. COVILLE.

THE Harriman Alaska Expedition of 1899 furnished an opportunity to observe and collect specimens of most of the willows of the Alaskan coast south of Bering Strait. The species were distinguished in the field without much difficulty, but the labor required to find the correct names of the species was greater, since it involved a careful review of all the literature on the subject and an equally careful examination of all accessible Alaskan collections. It has not been possible to examine the willows collected in that territory by the expeditions of various European nations, and in view of that fact I desire to express here the same hope as did Trautvetter in his admirable treatise *De Salicibus Frigidis* published in 1832 :

Errare quidem humanum est, sed discrimen statuimus inter errores, qui excusari possunt et qui non possunt. . . . Solatio mihi est spes, vos, benevolos lectores, errores meos in iis numeraturos esse, qui excusari possint.

Twenty-three species of willows are enumerated in the present paper. Two of these, *Salix arbusculoides* and *Salix myrtillofolia*, were collected only on the Canadian side of the Alaskan

boundary but so near it as to warrant the assumption that they occur on the other side also. Several species reported from Alaska, in local lists, have been omitted, chiefly because the obvious errors of some identifications throw doubt on all. It is probable, however, that Alaska contains species additional to those herein admitted. These are to be expected along the whole eastern boundary of the territory, where least systematic collecting has been done and where the chance of intrusion of species from the interior continental flora is greatest.

Of the twenty-three Alaskan willows, five are trees, 10 to 30 feet high, seven are erect bushes, commonly 2 to 8 feet high, and eleven are prostrate. The species in these groups are as follows :

TREE SPECIES.

<i>S. alaxensis</i>	<i>S. bebbiana</i>
<i>S. amplifolia</i>	<i>S. nuttallii</i>
<i>S. sitchensis.</i>	

BUSH SPECIES.

<i>S. arbusculoides</i>	<i>S. glauca</i>
<i>S. barclayi</i>	<i>S. niphoclada</i>
<i>S. commutata</i>	<i>S. pulchra</i>
<i>S. richardsoni.</i>	

PROSTRATE SPECIES.

<i>S. arctica</i>	<i>S. myrtillofolia</i>
<i>S. chamissonis</i>	<i>S. ovalifolia</i>
<i>S. fuscescens</i>	<i>S. phlcbophylla</i>
<i>S. glacialis</i>	<i>S. polaris</i>
<i>S. leiocarpa</i>	<i>S. reticulata</i>
<i>S. stolonifera.</i>	

Salix myrtillofolia is a rare species of whose habit there is no precise collector's record. Our specimens indicate that it is normally a prostrate plant but that when growing in sphagnum moss it tends to assume a somewhat upright form, a character observed in *Salix fuscescens* when growing in sphagnum bogs to the south of its more typical range on the northern tundra. Those bushy willows which range upward to timber line or northward to the tundra, as for example *Salix pulchra*, often

become prostrate from the severe climatic conditions to which they are exposed, particularly by their long enforced prostration beneath the snow and the repeated killing of upward shoots by cold winds. When these adverse conditions are removed such species assume their normal form. When a tree species flowers young, as is often true of *Salix sitchensis*, it may easily be mistaken for a bush willow; but an observation of the average height of mature plants will prevent error from such a source. Under very adverse surroundings even a tree willow may become prostrate, a condition observed in *Salix alaxensis* on the gravels at the terminal moraine of Muir Glacier.

Only one of the willows enumerated, *amplifolia*, is confined to Alaska, and on the other hand only two, *reticulata* and *glauca*, are strictly circumpolar. Between these two extremes of very restricted and very wide range, the species show three definite geographic relationships, with Siberia, with the Pacific Northwest Coast, and with the Interior of British America. Excluding the strictly circumpolar species, the willows common to Siberia and Alaska are

<i>S. alaxensis</i>	<i>S. leiocarpa</i>
<i>S. arctica</i>	<i>S. ovalifolia</i>
<i>S. chamissonis</i>	<i>S. phlebophylla</i>
<i>S. fuscescens</i>	<i>S. polaris</i>
<i>S. pulchra.</i>	

One of these Siberia-Alaska species, *alaxensis*, is a tree, another, *pulchra*, a bush, and the remainder are prostrate. All the prostrate species belong to the true arctic or arctic alpine flora. Some of them overlap into the Hudsonian flora, while *pulchra* and *alaxensis* are Hudsonian species which abut against and even intrude into the arctic flora. The Alaskan willows of Siberian relationship may be considered, therefore, prevailingly arctic.

The species showing a relationship to the flora of the interior of the North American continent are:

<i>S. arbusculoides</i>	<i>S. niphoclada</i>
<i>S. bebbiana</i>	<i>S. nuttallii</i>
<i>S. myrtillofolia</i>	<i>S. richardsoni.</i>

Four of these species, *arbusculoides*, *myrtillofolia*, *niphoclada*, and *richardsoni*, are believed to belong to the Hudsonian flora, and two, *bebbiana* and *nutallii*, to the next southerly flora, the one known technically as the Canadian. Thus, while there is considerable diversity in the zonal relationship of the species of this group, they may be considered prevailing Hudsonian, or one stage more southerly than the Siberian species.

The remaining species, four in number, belong to the Pacific coast flora. They are:

<i>S. barclayi</i>	<i>S. sitchensis</i>
<i>S. commutata</i>	<i>S. stolonifera</i> .

Stolonifera is a local alpine species occupying a restricted area in the coast range of mountains from the vicinity of Juneau to Yakutat Bay, and the others are characteristic species of the so-called Sitkan flora, a modified Canadian flora with some Hudsonian elements, all adapted to the conditions of great humidity that prevail along a narrow strip of the Pacific coast from Oregon to southern Alaska. The average zonal position of these species is about the same as that of the preceding group.

To facilitate the identification of specimens, two keys have been prepared, a shorter one intended for use with typical specimens, and a longer one intended to bring out more precisely the characters of the various species and to cover the normal variations. The specimens cited cover primarily the collections of the Harriman expedition. Secondarily they cover the collections of Alaskan willows in the National Herbarium, and in the herbaria of the Missouri Botanical Garden, the New York Botanical Garden, and Columbia University. The last three collections, through the courtesy of the directors of these institutions, were loaned for use in preparing this paper.

As a further aid in recognizing species, each is illustrated by drawings made by Mr. F. A. Walpole. The drawings for the plates were made in the field from living plants; those for the text figures were made from herbarium specimens.

KEY TO ALASKA WILLOWS, BASED ON TYPICAL COMPLETE SPECIMENS.

Ovaries smooth.

Catkins sessile on old wood.....*S. richardsoni*, p. 315.

Catkins terminal on leaf-bearing, though sometimes very short and small-leaved, branches.

Plant an erect bush or tree.

Plant a tree, the leaves without stipules.. *S. amplifolia*, p. 314.

Plant a bush, the leaves with toothed stipules.

Leaves glaucous beneath, the catkin scales black.

S. barclayi, p. 316.

Leaves green beneath, the catkin scales yellowish.

S. commutata, p. 317.

Plant prostrate.

Leaves crenate about the whole margin.

S. myrtillofolia, p. 325.

Leaves entire or sparingly toothed toward the base.

Leaves bright green and shining on both surfaces.

S. leiocarpa, p. 338.

Leaves glaucous beneath.

Style about 1.5 mm. long..... *S. stolonifera*, p. 333.

Style about .5 mm. or less in length.

Pedicels about three times as long as the nectaries,
style almost wanting..... *S. fuscescens*, p. 329.

Pedicels not longer than the nectaries, style about .5
mm. long..... *S. ovalifolia*, p. 331.

Ovaries hairy.

Catkin scales several times longer than their hairs, filaments hairy
below..... *S. reticulata*, p. 340.

Catkin scales little or not at all longer than their hairs, filaments
smooth throughout.

Catkin scales yellowish throughout.

Pedicels several times the length of the nectaries, in fruit ex-
ceeding the catkin scales..... *S. bebbiana*, p. 306.

Pedicels at most three times the length of the nectaries, never
exceeding the scale.

Leaves acute at the base, on petioles several millimeters in
length..... *S. glauca*, p. 321.

Leaves rounded at the base, on petioles 2 mm. or less in
length..... *S. niphoclada*, p. 322.

Catkin scales black, at least at the apex.

Leaves finely and evenly serrate or crenate about the whole
margin.

Plant erect, the leaves oblanceolate, sericeous beneath.

S. arbusculoides, p. 323.

Plant prostrate, the leaves obovate, smooth beneath.

S. chamissonis, p. 325.

Leaves entire or remotely denticulate.

Plant prostrate.

Leaves bright green on both sides.

S. phlebophylla, p. 336.

Leaves pale or glaucous beneath.

Twigs barely 1 mm. in diameter, rooting in the second year.....*S. polaris*, p. 335.

Twigs thicker, seldom rooting.

Catkin ovoid-globose, style almost none.

S. glacialis, p. 329.

Catkin cylindrical, style well developed.

S. arctica, p. 326.

Plant an erect bush or tree.

Leaf smooth on both surfaces.....*S. pulchra*, p. 319.

Leaf with some permanent pubescence beneath.

Leaf with a white tomentum of curled hairs beneath.

S. alaxensis, p. 311.

Leaf with dense or scanty short appressed hairs beneath.

Catkins appearing before the leaves, the permanent pubescence of the latter beneath very scanty, stamens 2 in each flower.....*S. nuttallii*, p. 310.

Catkins appearing with the leaves, the permanent pubescence of the latter beneath dense and satiny, stamens 1 in each flower.....*S. sitchensis*, p. 307.

KEY TO ALASKA WILLOWS, BASED ON PISTILLATE LEAF-BEARING SPECIMENS.

Leaves obovate, usually wedge-shaped at the base, glabrous, usually glaucous beneath, minutely and closely glandular-serrate, not crenate, about the whole margin; plant prostrate.

S. chamissonis, p. 325.

Leaves not with all the characters given above, particularly with reference to the serration; plant often erect.

Leaves not exceeding 2 cm. in length, without stipules, bright green and shining on both surfaces, not glaucous beneath, entire, glabrous, except for the few long hairs usually present on the margin, a few of the principal veins standing out very conspicuously on the fresh leaves and often forming a skeleton after a few years from the weathering of the softer matter of the persistent dead leaves.

Leaves broadly obovate or orbicular, rounded or retuse at the apex, commonly 4 to 6 mm., and rarely exceeding 10 mm., in length; pistillate catkins globose to oblong, few- (usually 2- to 8-) flowered; ovary smooth.....*S. leiocarpa*, p. 338.

Leaves oblanceolate to obovate, acute to obtuse at the apex, tapering to the base, commonly 10 to 15 mm. long; pistillate catkins cylindrical, many-flowered; ovary usually hairy.

S. phlebophylla, p. 336.

Leaves not with all the characters given above.

Leaves orbicular to oval, glaucous and very prominently reticulated beneath, rugose above; catkins equaled or nearly equaled by their peduncles; scales of the catkins reddish purple, usually smooth on the outside, several times longer than the hairs of the margin and inner surface; capsules hairy; stigma sessile or nearly so..... *S. reticulata*, p. 340.

Leaves or other parts not as described above.

Plant prostrate, caespitose; branches very slender, a millimeter or less in diameter, becoming firmly rooted; leaves oval to orbicular or nearly so; catkins oblong to globose; ovaries hairy or sometimes nearly smooth, but not glaucous; style plainly developed but less than a millimeter in length.

S. polaris, p. 335.

Plant not with all the characters given above.

Leaves very smooth on both surfaces, except for a few long hairs (early deciduous) on the margins and midrib when young, bright green and shining above, glaucous beneath, rhombic-oblanceolate or sometimes rhombic-obovate, narrowly wedge-shaped at base and usually at the apex also; stipules narrowly linear-lanceolate, persistent, serrate; catkins sessile or nearly so on old wood, the scales black, oblanceolate; stalk of the hairy capsule about as long as the nectary; style about 1 to 1.5 mm. long. *S. pulchra*, p. 319.

Leaves or other parts not as described above.

Ovary and capsule smooth, at least over most of its surface.

Plant prostrate or nearly so, less than a foot in height.

Leaves finely and evenly crenate about the whole margin; catkins almost sessile, but the very short peduncle bearing a few small leaves.

S. myrtillofolia, p. 325.

Leaves entire, or sometimes with a few scattered teeth below, catkins borne on a well-defined leafy peduncle

or branch of the season half a centimeter to two or three centimeters long.

Leaves rhombic-obovate, narrowed toward the base, broadest above the middle; pedicel of the ovary about three times the length of the nectary; capsule shining, not glaucous; style almost none, barely .25 mm. in length.

S. fuscescens, p. 329.

Leaves oval to orbicular, sometimes obovate; pedicel of the ovary little or not at all exceeding the nectary; style evident.

Capsule glaucous; style about .5 mm. long.

S. ovalifolia, p. 331.

Capsule not glaucous; style about 1.5 mm. long.

S. stolonifera, p. 333.

Plant an erect bush or tree.

Plant a tree with oval leaves when fully developed 3 to 5 cm. wide, and devoid of stipules; catkins about 1.5 cm. in diameter in flower and often 2 cm. in fruit.....*S. amplifolia*, p. 314.

Plant a shrub, commonly 1 to 2 meters high; leaves usually smaller, commonly oblong-lanceolate (though sometimes as broad and large as the last), and with ovate to lanceolate, glandular-denticulate stipules.

Stems densely hirsute; stipules usually persistent for several years on the stout stems; catkins sessile on old wood, all leaves and green bracts appearing later and from separate buds.

S. richardsoni, p. 315.

Stems often smooth; stipules seldom persistent on old wood; catkins on short leafy-bracted peduncles appearing with the leaves.

Leaves crenate-serrate (the somewhat gland-tipped teeth incurved), glaucous beneath, though this character sometimes obscure in young leaves; catkin scales usually black.

S. barclayi, p. 316.

Leaves finely glandular-denticulate (the teeth not incurved) throughout or only toward the base, or entire, not glaucous beneath, of nearly the same

color on both surfaces; catkin scales usually yellowish or straw-colored.

S. commutata, p. 317.

Ovary densely hairy, the capsule by expansion more sparingly so.

Leaves provided beneath with a dense, white, opaque covering of curled and tangled hairs.

S. alaxensis, p. 311.

Leaves not as described.

Leaves rather narrowly elliptical-lanceolate, acute at both ends, minutely and rather closely crenate-denticulate about the whole margin, glaucous beneath, the lowermost usually smooth on both surfaces, the upper clothed beneath with fine appressed hairs; stalk of the ovary equalling or twice as long as the nectary; style less than 1 mm. long.

S. arbusculoides, p. 323.

Leaves or other parts not as described.

Catkins appearing before the leaves, the usually very short peduncle devoid of leaves, though sometimes with very rudimentary leaves or bracts; leaves with permanent appressed pubescence of short hairs beneath, dense when young, sparse when old, the upper surface with some similar pubescence above when young, oblong-lanceolate to obovate-lanceolate, usually acute at either end; catkin scales black; style short, 5 mm. or less in length.....*S. nuttallii*, p. 310.

Catkins appearing with or after the leaves, the fresh growth on which the catkin is borne always having either leaves or green leaf-like bracts; other organs not all as described above.

Leaves oblanceolate to obovate, tapering to the base, usually rounded at the apex, entire or remotely glandular-denticulate, permanently satiny beneath with a dense covering of very short, straight, appressed hairs.

S. sitchensis, p. 307.

Leaves not as described.

Stalk of the ovary few to several times the length of the nectary, very slender, in fruit

exceeding the scale and sometimes becoming twice or three times as long.

S. bebbiana, p. 306.

Stalk of the ovary not more than twice or sometimes three times the length of the nectary but always shorter than the scale.

Plant an erect shrub; leaves permanently clothed on the lower surface, and sometimes also the upper, with a usually sparse covering of long appressed hairs; scales of the catkin light brown to straw-colored.

Leaves wedge-shaped at the base, on petioles several millimeters in length.

S. glauca, p. 321.

Leaves rounded or cordate at the base, on very short petioles, those on our specimens 2 mm. or less in length.

S. niphoelada, p. 322.

Plant prostrate; leaves often with some long silky hairs when young but glabrous at maturity, or with hairs only on the margins or midrib; scales of the catkin almost always black.

Leaf-blade 1.2 cm. or less in length; catkin short, ovoid-globose; style reduced to a mere neck... *S. glacialis*, p. 329.

Leaf-blade usually much larger; catkin elongated, cylindrical; style well developed..... *S. arctica*, p. 326.

1. SALIX BEBBIANA Sargent. Bebb Willow.

Salix rostrata RICHARDSON in Franklin, Journ. Pol. Sea 753. 1823; not Thuill. 1799.

Salix bebbiana SARGENT, Gard. & For. 8: 463. 1895.

A small tree with leaves elliptical-lanceolate or ovate-lanceolate, either rounded or acute at the base, acute or acuminate at the apex, sparingly pubescent when young, becoming nearly smooth in age, usually crenate-denticulate, but sometimes entire, commonly 3 to 5 cm. long. The pale brown or straw-colored catkin scales, the pubescence of the slender ovaries, their very long slender pedicels, and the almost complete absence of a style are especially characteristic of the species. It is widely distributed, extending almost entirely across British

America. It occurs in most of the northern portions of the United States, reaching southward in the east to Pennsylvania, in the Rocky Mountain region to New Mexico and Arizona, and on the Northwest Coast to Oregon. The original specimens were collected on Sir John Franklin's first expedition, in the interior of British America. In Alaska the species has a very restricted range from the upper waters of Cook Inlet eastward to the upper Yukon Valley. Near Homer, in Cook Inlet, on the brushy portion of the point, it is reported by Mr. Evans as a shrub or small tree 4 to 15 feet (1.2 to 4.5 meters) high, at Kasilof¹ 10 to 25 feet (3 to 7.5 meters) high and 8 inches (20 cm.) in diameter.

The following specimens have been examined:

Cook Inlet.—At Homer, Sunrise, and Kasilof, Walter H. Evans, 1897 (Nos. 470, 491), 1898 (No. 693). At Kenai, F. A. Walpole, 1900 (No. 1143). Between Cook Inlet and the Tanana River, probably from the lower Sushitna, E. F. Glenn, 1899.

Yukon Valley.—Near the junction of Forty-mile Creek and the Yukon, Frederick Funston, 1893 (Nos. 39, 42). At Fort Yukon, F. C. Schrader, 1899.

Dr. P. A. Rydberg has published recently,² while this paper was in press, a *Salix perrostrata*, based primarily on specimens collected by himself near Hermosa, in the Black Hills of South Dakota, and to that species he has referred a specimen collected by Mr. R. S. Williams at Dawson, Yukon Territory, besides assigning the species a range northwestward to Alaska. While his bibliographical references indicate that the species is a segregate from *bebbiana*, the author gives no comparison of distinguishing characters. I am unable to find in his description anything to distinguish our Alaskan specimens from what I take to be typical *bebbiana*, whatever may prove to be the relation of that species to the Black Hills willow.

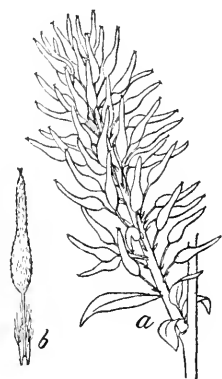


FIG. 17. *Salix bebbiana* Sargent: a, fruiting catkin, natural size; b, capsule, with pedicel, scale, and nectary, enlarged two diameters.

2. SALIX SITCHENSIS Sanson. Satin Willow.

Plate XXXIII.

Salix sitchensis SANSON; BONGARD, Mem. Acad. Petersb. VI. Math. & Nat. 2: 162. 1831.

¹ Various spelled Kassiloff, Kassilof, Kussilof, Kussilow, etc.

² Bull. N. Y. Bot. Gard. 2: 163. 1901.

Salix sitchensis is ordinarily a large shrub or small tree, individual specimens often reaching 10 to 15 or rarely 30 feet (3 to 9 meters) in height, with a trunk four to six inches or occasionally even a foot (10 to 30 cm.) in diameter. In exposed situations it sometimes flowers and fruits as a small shrub a few feet in height, and on the bare morainal gravels at Muir Glacier it even joined the other smaller willows in becoming almost prostrate. In addition to the attractiveness of a rather graceful form, this willow bears a foliage of singular beauty. On close inspection the leaves present a satiny sheen of daintiest delicacy and softness, varying in intensity with the unevenness of the leaf surface. This appearance, largely lost in the dried specimens, is due to a dense covering, on the lower surface of the leaves, of closely appressed short hairs. No other Pacific Coast willow has the same character, and when one has known it in the field he can, by its foliage alone, readily distinguish this satin willow from all the other species. The leaves are oblanceolate to obovate, broadly acute to obtuse at the apex, narrowed at the base, entire or sometimes remotely denticulate, and when fully developed about 4 to 6 cm. long, except on vigorous shoots, where they often reach 10 cm. The flowers of the male catkins have but a single stamen each. All other Alaskan willows have two stamens.

Salix sitchensis is a characteristic plant of the Sitkan floral district, extending from the southernmost limit of Alaska northward and westward along the coast to Cook Inlet and the eastern end of Kadiak Island. It was observed at as high an elevation as 1,400 feet. Where the forests of Sitka spruce were dense this willow grew along the streams and beaches and in similar sunshiny situations, but where the forest was open or wanting it might occur anywhere on the solid upland at the proper elevation. South of Alaska, *Salix sitchensis* extends along the coast to California, and along the mountains through British Columbia into the Cascade Range of Washington and Oregon.

The wood of the satin willow is sometimes used by the Indians of southern Alaska in drying salmon, since its smoke does not give the fish a bad taste as do some other kinds of fuel. Its pounded bark is sometimes applied directly to a cut or wound, to assist in healing. The Tlinkit tribes, which extend from Yakutat Bay nearly or quite to Dixon Entrance, call it *chahtl*, or more precisely, *ch'ä'-llh*.¹ They give the same name to other and probably to all the species of willow in that region. This shows how little the willows enter into their useful arts, for wherever in the United States the willow is employed in

¹ The diacritic marks used are those of the Century Dictionary.

basket making or other arts, the widely differing qualities of the various species have caused the Indians to give them discriminating names. Among the natives of Kadiak the word for various other species of willow, *nimuyok* (*ni-mó-yäk'*), is doubtless applied to the satin willow also.

Specimens of *sitchensis* have been examined as follows :

Behm Canal.—At "Shehshooh¹ Lake," M. W. Gorman, 1895 (No. 38).

Wrangell.—On the hillside back of the town, Coville and Kearney (No. 426), Trelease and Saunders (Nos. 335², 3363), Walter H. Evans, 1897 (No. 78).

Sitka.—Along Indian River, Coville and Kearney (No. 838), A. Kellogg, 1867 (175, in part), Walter H. Evans, 1897 (No. 228). It was here, undoubtedly, that Henry Mertens, the botanist of Lütke's Expedition, in an excursion from Sitka to the summit of the neighboring Mount Verstovia, in the year 1827, discovered this willow. And here the writer on June 16, 1899, on a similar excursion found it still growing. The dense forests of spruce about Sitka do not afford suitable conditions for the tree, and it was not observed at any other point in the vicinity. Exactly similar was the situation in Mertens' time. He says, "Here alone [at the crossing of a 'wild mountain current'] is seen the solitary species of *Salix* which the environs of Sitka afford."²

Stephens Passage.—At Taku Harbor, Coville and Kearney (No. 481).

Juneau.—In and above Silver Bow Basin, Coville and Kearney (Nos. 566, 594, 2534), Walter H. Evans, 1897 (No. 155).

Skagway.—At Glacier on the White Pass railroad, F. A. Walpole, 1900 (No. 1264).

Glacier Bay.—Abundant at various points, Coville and Kearney (Nos. 624, 633, 634, 698a, 701), Trelease and Saunders (Nos. 3354, 3355, 3377, 3378), Brewer and Coe (Nos. 38, 39), Kincaid.

La Perouse Glacier.—Near the beach, west of the glacier, Fernow.

Yakutat Bay.—At many points, Coville and Kearney (Nos. 998 to 1000, 1082a, 1121, 1154), Trelease and Saunders (Nos. 3357, 3358, 3360, 3361, 3369).

Kadiak Island.—At English Bay, about 8 miles south of Kadiak³ village, Coville and Kearney (No. 1440).

¹ Supposed to be the lake at the head of Yes Bay.

² See Hooker, Bot. Misc. 3: 18. 1833.

³ This is Woman's Bay of some charts, having been named *babia* (*woman's*) by the Russians. W. H. Osgood and F. A. Walpole report that it is known at Kadiak by the name English Bay only.

3. *SALIX NUTTALLII* Sargent. Nuttall Willow.

Salix flavescens NUTT. Sylv. 1: 65. 1842, not Host, 1828.

Salix nuttallii SARGENT, Gard. & For. 8: 463. 1895.

A small tree 3 to 5 meters (about 10 to 16 feet) in height and commonly 7.5 to 10 cm. (3 to 4 inches) in diameter. The leaves are ovate to oblanceolate, tapering at the base, acute or sometimes obtuse

at the apex, entire or occasionally somewhat crenate-denticulate, the lower surface with some scattered appressed hairs or, on vigorous shoots, a somewhat velvety pubescence, but without the satiny lustre of *sitchensis*. When in flower this willow is conspicuous for its leafless twigs and the prominence of the black, sparsely hairy catkin scales. The original specimens were collected by Nuttall "in the range of the Rocky Mountains" at some point near the present route of the Union Pacific railway from Nebraska to Oregon.

Our Alaska material is as follows:

Skagway to Lake Bennett.—From Skagway to Glacier on the White Pass

railway, Coville and Kearney (Nos. 493, 503), F. A. Walpole, 1900 (No. 1076). From Bennett to Log Cabin, F. A. Walpole, 1900 (Nos. 1083, 1271). At Lake Bennett, J. B. Tarleton, 1899 (No. 21).

Cook Inlet.—At Halibut Cove in Kachemak Bay, Coville and Kearney (No. 2416), the specimens in leaf only.

The name *Salix nuttallii* is ordinarily used to designate a species (or perhaps a group of species) finding its eastern limit in the Rocky Mountains and its western limit at the shore of the Pacific. It occurs as far south as Utah and Arizona, and in California extends southward along the coast to the bay of Monterey and along the Sierra Nevada to the San Bernardino range. Northward from California it is

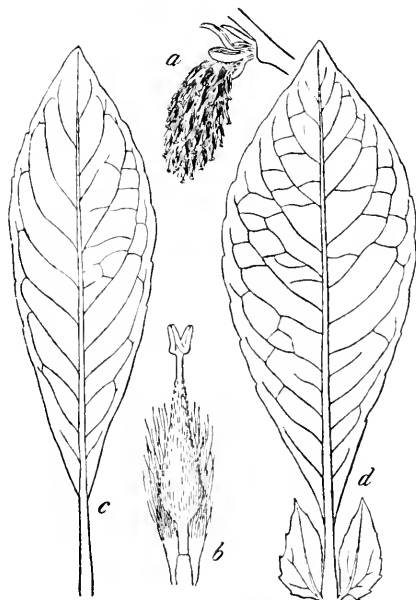


FIG. 18. *Salix nuttallii* Sargent: *a*, pistillate catkin, natural size; *b*, pistillate flower, enlarged six diameters; *c*, *d*, leaves, natural size.

abundant along the coast and in the mountains to British Columbia. The form that occurs along the Pacific Coast from California to British Columbia differs in several respects from the Rocky Mountain plant and has been designated, either as a species or a variety, by the names *brachystachys*, *capreoides*, and *scouleriana*. My attention has recently been called by Professor C. V. Piper to the fact that this last name, *scouleriana*,¹ is a valid name, and the oldest name, for the Pacific Coast plant, and is older than the name *nuttallii*. It appears that Andersson in making a critical identification of the type specimens of *scouleriana*,² found that the leaf specimen belonged to *sitchensis*, while the flowering specimen, which therefore represented the real *scouleriana*, he referred to *Salix flavescens* Nutt. Professor Sargent, finding *flavescens* to be a homonym and considering the Rocky mountain plant and the Pacific Coast plant to belong to the same species, followed a course which was inadmissible under the circumstances and gave the species a new name, *nuttallii*, instead of taking up *scouleriana*. Until a critical revision of these willows has been made it will probably be most convenient and least confusing to treat *scouleriana* and *nuttallii* as distinct species.

Salix nuttallii, like *Salix bebbiana*, evidently reaches Alaska by an extension of its range in the interior of British America, through the humid Sitkan flora, to the coast at Skagway and Cook Inlet. *Salix scouleriana* apparently does not extend as far north as Alaska. Its only claim to admission into that flora rests on some imperfect young specimens from Wrangell, without flowers or fruit, which may be referable to *sitchensis*. Kellogg's specimens of *scouleriana*, reported as collected at Kadiak and Sitka, in fact came from Vancouver, British Columbia.

4. SALIX ALAXENSIS (Anders.) Coville. Feltleaf Willow.

Plate xxxiv.

Salix speciosa HOOK. & ARN. Bot. Beech. Voy. 130. 1832, not Host, 1828.

Salix speciosa alaxensis ANDERS. in DC. Prodr. 16²: 275. 1868.

Salix alaxensis COVILLE, Proc. Wash. Acad. Sci. 2: 280. 1900.

Salix longistylis RYDBERG, Bull. N. Y. Bot. Gard. 2: 163. 1901.

This willow differs notably in its foliage from all the other Pacific Coast species, so much so, indeed, that Hooker and Arnott, the conservative authors of the 'Botany of Captain Beechey's Voyage in the Blossom,' described the plant from specimens devoid of flowers or fruit. The under surface of the leaves is covered with a dense white

¹ Barratt; Hook. Fl. Bor. Am. 2: 145. 1838-9.

² See Bebb, Gard. & For. 8: 373. 1895.

wool or felt made up of curled and tangled hairs, presenting an appearance quite different from the velvety, or satiny, or cobwebby pubescence of other species. The leaves are narrowly to broadly elliptical-lanceolate, acute at the apex and base, smooth or nearly so on the upper surface, of an apparently thick texture, due largely to the dense woolly covering of the lower surface, often corrugate-reticulate, the margins of the very young leaves often minutely glandular-denticulate, at maturity usually entire and sometimes revolute, the stipules usually present, narrowly linear-lanceolate to filiform, and entire. The fruiting catkins are very long and thick, some of those collected reaching a length of 14 cm. and a diameter of 1.8 cm. The stout twigs are either smooth or densely hairy, and sometimes they have a decidedly blue color from the presence of a conspicuous bloom.

Salix alaxensis extends from the northern part of Alexander Archipelago westward along the Alaskan coast to the peninsula, northward along the eastern side of Bering Sea through Bering Strait to Cape Lisburne, and through the interior of Alaska to the Mackenzie River in British America. East of Kadiak it is associated with other species of tree willows, but west of that point it is the only willow that presents the form and dimensions of a tree. From the Shumagin Islands eastward full-grown specimens are ordinarily about 20 to 30 feet (6 to 9 meters) in height, with a trunk four to six inches (10 to 15 cm.) in diameter. Under suitable conditions it doubtless reaches a still larger size. On the wind-swept Aleutian Islands, like all other arboreal vegetation, it appears to be wanting, but on the mainland to the north it again appears, on Buckland River, at the eastern end of Kotzebue Sound, reaching a height of 16 to 20 feet (according to Seemann in the 'Botany of the Herald'), farther north in the sound only eight feet, and at its northern limit, Cape Lisburne, being reduced to a shrub only two feet high. Like *Salix sitchensis*, it becomes almost prostrate on the naked gravels at Muir Glacier, while only a few miles away, on older glacial deposits which have been reclothed with an abundant vegetation of shrubs, it develops into a handsome small tree, a difference of habit illustrating the marked effect of different local conditions.

The original specimens of Hooker and Arnott's *speciosa* came from Kotzebue Sound, those of Andersson's *speciosa alaxensis* from "Alaxa Americae occidentali-borealis."

The feltleaf willow holds an important economic relation to the mining industry and to human existence generally in northern Alaska, for while spruce timber apparently does not extend north of the divide

separating the waters of the Yukon and the rivers flowing into Kotzebue Sound from those of the Arctic coast, this tree-willow does extend beyond that divide to the headwaters of the Arctic rivers, and in many places furnishes the only wood available as fuel to Indians, prospectors, and explorers.

Mr. Rydberg's *Salix longistylis*, based on a specimen collected at the mouth of Klondike Creek, Yukon Territory, although compared by him only with *Salix sitchensis*, is clearly identical with the present species.

Specimens of *Salix alaxensis* have been examined as follows :

Skagway and White Pass.—At Glacier on the White Pass railroad, and at Skagway, F. A. Walpole, 1900 (Nos. 1071, 1077, 1106).

Lake Bennett.—On the shore and uplands, J. B. Tarleton, 1899 (No. 12, in part).

Glacier Bay.—At various points about the bay, Coville and Kearney (Nos. 622, 639, 663, 696, 698, 699, 702), Trelease and Saunders (Nos. 3344 to 3348, 3364), Brewer and Coe (No. 57), Walter H. Evans, 1897 (No. 156).

Takutat Bay.—Abundant on the west side of the bay, and at its northern end and arms, Coville and Kearney (Nos. 996, 1058, 1120, 1149), Trelease and Saunders (Nos. 3349, 3359, 3470, in part).

Prince William Sound.—At Port Wells, Coville and Kearney (No. 1270), Trelease and Saunders (No. 3372), Brewer and Coe (No. 136).

Cook Inlet.—At several points between the head of Cook Inlet and the Tanana River, E. F. Glenn, 1899. Sparingly on the delta of a glacier at Halibut Cove, Kachemak Bay, Coville and Kearney, No. 2419).

Kadiak Island.—Sparingly on the lower mountain slopes in English Bay, Coville and Kearney (No. 1441). Near Kadiak village, Trelease and Saunders (No. 3351), Brewer and Coe (No. 223).

Shumagin Islands.—Sparingly at Sand Point and in other localities on Popof and Unga, Coville and Kearney (No. 1622), Trelease and Saunders (No. 3343), M. W. Harrington, 1871-2. At Mist Harbor, Nagai Island, C. H. Townsend, 1893.

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (No. 1622), Trelease and Saunders (No. 3350); in Stepovak Bay, Palache; and at Nushagak, C. L. McKay, 1881.

Yukon Valley.—Headwaters of Koyukuk River, F. C. Schrader, 1899. At Rampart House, on the Porcupine River, Frederick Funston, 1894 (No. 175). At Dawson, Yukon Territory, R. S. Williams, 1899.

Kotzebue Sound.—At Camp Retreat, on the delta of the Kowak or Putnam River, G. M. Stoney, 1886.

5. *SALIX AMPLIFOLIA* Coville. Yakutat Willow.

Plate xxxv.

Salix amplifolia COVILLE, Proc. Wash. Acad. Sci. 2: 282. *pl.* 15. 1900.

A shrub or small tree, ordinarily about 10 to 16 feet (3 to 5 meters) high, with a trunk three to four inches (7.5 to 10 cm.) in diameter, but sometimes attaining a height of 25 feet (7.5 meters) with a trunk a foot (30 cm.) thick. The young twigs are stout and densely villous-pubescent. The leaves are large, oval to broadly obovate, 5 to 8 cm. long when fully developed, entire, or denticulate on the margins below, somewhat villous when young, smooth or nearly so at maturity, without stipules. The catkins, appearing with the leaves on leafy-bracted peduncles, are very large and thick, about 1.5 cm. in diameter and 4 to 6 cm. in length, the fruiting catkins often becoming 2 cm. in diameter. The ovary and capsule are smooth, the style commonly 3 to 4 mm. long. Occasionally the ovaries are slightly hairy. The species is known only from Yakutat Bay, Alaska, where it was discovered by the Harriman Expedition. The tree was first observed on the west shore of the bay growing on and near the sand dunes that lie back of the beach, and was afterward collected in Disenchantment Bay at Egg Island, Hubbard Glacier, and Haenke Island, and later at the Indian village at the head of Yakutat Bay, east shore. Specimens were collected by Coville and Kearney (Nos. 1013a, 1061, 1062, 1074, 1089, 1122, 1123, 1153, 1158), Trelcase and Saunders (Nos. 3340 to 3342, 3465), Brewer and Coe (Nos. 89, 90), and Fernow. The type specimen, No. 1153, was collected at the Indian village, not as stated in the original description on the west shore of the bay.

Salix amplifolia bears considerable resemblance to *richardsoni* and *barclayi*, but the species from which it differs least is *Salix hookeriana* Barratt, which occurs on the sea coast from Oregon to British Columbia. Like *amplifolia*, *hookeriana* lacks the stipules so conspicuous in *richardsoni* and in *barclayi*, but *hookeriana* is readily distinguishable from the Yakutat tree by its shorter styles, about 1 mm. in length, the permanent though sometimes thin tomentum on the backs of the leaves, the earlier appearance of the catkins, which precede the leaves, and the absence or rudimentary character of the green bracts on their peduncles.

6. *SALIX RICHARDSONI* Hook. Richardson Willow.

Salix richardsoni Hook. Fl. Bor. Am. 2: 147. t. 182. 1838-9.

An erect bushy willow, from a meter or sometimes less to 2.5 meters in height, the branches stout and hairy, and retaining the dead stipules of the preceding year's growth. These stipules are lanceolate, glandular-serrate, and very large, commonly 1 to 2 cm. in length. The catkins, which appear before the leaves, are sessile on one-year-old wood, stout, and closely flowered, with densely long-hairy scales but smooth long-styled ovaries and capsules. The leaves are bright green, smooth on both sides (the scant cobwebby hairs present in the unfolding leaf-buds very early deciduous), paler and at maturity perhaps glaucous beneath, oblong-ovate to obovate-lanceolate, apparently 3 to 6 cm. long at maturity, sparingly glandular-denticulate, particularly toward the base, on short woolly petioles. This willow was originally collected by Richardson, naturalist of Sir John Franklin's expeditions, at Fort Franklin on the Mackenzie River in the interior of northern British America. We now have specimens from the vicinity of White

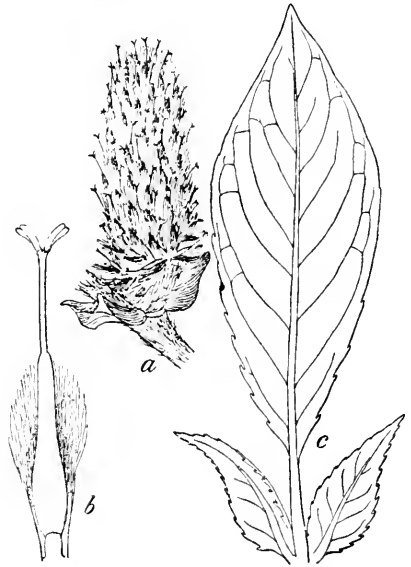


FIG. 19. *Salix richardsoni* Hook.: *a*, pistillate catkin, showing at the base two persistent stipules of the preceding season's development, natural size; *b*, pistillate flower, enlarged six diameters; *c*, leaf, natural size.

Pass, Alaska, and from Port Clarence, indicating an extensive range in the interior of Alaska and the interior of northwestern British America.

Specimens have been examined as follows:

Mackenzie.—At Fort Franklin, on Mackenzie River, Richardson. One of the labels reads, "7 feet high, erect and spreading."

Tukon.—On the shore of Lake Bennett, J. B. Tarleton, 1899 (Nos. 12, in part, 14). Marked "5 to 8 feet high."

Port Clarence.—In a brushy area along a stream in the tundra, Coville and Kearney (No. 1874).

Seemann in his Botany of the Herald, page 40, reports *Salix richardsoni* as occurring on the Arctic sea coast of Alaska from Kotzebue Sound to Cape Lisburne, but his description of the ovaries as "covered with a slight down" throws doubt on the identification and suggests that they may belong to *Salix pulchra*. The willow from Kadiak reported by Kellogg as *richardsoni* proves to be *pulchra*.

In Hooker's original description the leaves of *Salix richardsoni* are described as "integerrimis." One of the duplicate type specimens from Fort Franklin, in the Columbia University Herbarium, has some partially developed leaves and these show a sparse denticulation precisely as in the Lake Bennett and Port Clarence specimens. The more nearly mature leaves of the Port Clarence plant indicate also that the base is not always as narrow as is shown in the Hooker plate.

7. SALIX BARCLAYI Anders. Barclay Willow.

Plate xxxvi.

Salix barclayi ANDERS. Oefv. Vet. Akad. Foerh. 15: 125. 1858.

Salix conjuncta BEBB, Bot. Gaz. 13: 111. 1888.

The commonest bush willow of the Alaskan coast. It is an erect shrub, ordinarily one to two, sometimes three, meters in height, with leaves oblong-obovate, acute or somewhat acuminate at the apex, rounded or wedge-shaped or even cordate at the base, commonly 4 to 7 cm. long, glaucous on the back, smooth or with scant villous or tomentose pubescence which is mostly early deciduous, the stipules ovate or ovate-lanceolate, toothed, persistent, and the ovaries smooth throughout. The characters given in the key distinguish it from related Alaskan species. It ranges throughout the coast region of southern Alaska, from Dixon Entrance northward and westward as far as Unalaska. Southward from Alaska it extends at least as far as the state of Washington. The original specimens of *Salix barclayi* were collected at a point near Cape Greville on Kadiak Island, Alaska, by George Barclay, the botanical collector of the British ship Sulphur, in 1839.

Alaskan specimens of this species have been examined as follows:

Wrangell.—On a hillside back of the town, Coville and Kearney (No. 444), Fernow.

Juneau.—In and near Silver Bow Basin, Coville and Kearney (No. 565), Grace E. Cooley, 1891, F. A. Walpole, 1900 (No. 1053).

White Pass and vicinity.—At various points about Skagway and along the White Pass railroad to Lake Bennett, F. A. Walpole, 1900 (Nos. 1055 to 1057, 1065, 1069, 1261, 1276).

Glacier Bay.—Common on almost all the shores of the bay, Coville

and Kearney (Nos. 623, 641, 652, 660, 700), Trelease and Saunders (Nos. 3406, in part, 3459 to 3461), Trevor Kincaid, 1897.

Takutat Bay.—Common all about the bay, Coville and Kearney (Nos. 1034, 1046, 1060, 1119, 1139, 1152), Trelease and Saunders (Nos. 3415, 3462, 3466 to 3468, 3471, 3473), Frederick Funston, 1892 (No. 6).

Prince William Sound.—In Port Wells and in Columbia Fiord, Coville and Kearney (Nos. 1260, 1361).

Cook Inlet.—At Kenai, F. A. Walpole, 1900 (No. 1144), and an abnormal form at Halibut Cove, Coville and Kearney (No. 2416a). Also between Cook Inlet and the Tanana River, E. F. Glenn, 1899.

Kadiak Island.—At various points near Kadiak village, Coville and Kearney (Nos. 1436, 2329), Trelease and Saunders (Nos. 3476, 3478, 3479), Fernow, Cole, A. Kellogg, 1867 (Nos. 175, in part, 221, in part), Walter H. Evans, 1897 (Nos. 313, 314), F. A. Walpole, 1900 (Nos. 1149 to 1153, 1158, 1159).

Alaska Peninsula.—At Kukak Bay, Trelease and Saunders (Nos. 3480, 3481).

Shumagin Islands.—On Popof and Unga, Coville and Kearney (No. 1796), Trelease and Saunders (Nos. 3453a, 3455), Kincaid, M. W. Harrington, 1871-2.

Unalaska.—Near Iliuliuk, Coville and Kearney (No. 1785), Fernow, C. Hart Merriam, 1891, J. M. Macoun, 1891, 1896, B. W. Evermann, 1892 (No. 19), Walter H. Evans, 1897 (No. 537).

For remarks on the relationship of this species with *Salix commutata*, see the notes under that species.

S. SALIX COMMUTATA Bebb. Greenbacked Willow.

Plate XXXVII.

Salix commutata BEBB, Bot. Gaz. 13: 110. 1888.

An erect bushy willow commonly .5 to 1.5 meters in height, similar to *Salix barclayi* but distinguishable by the characters given in the key. The most prominent difference lies in the color of the backs of the mature leaves, which in *barclayi* are covered with a conspicuous bloom but in *commutata* have no bloom, but nearly the same green color as the upper surface. The differences in the toothings of the leaf margins of the two species are indicated in the plates. The upper leaves on the leaf shoots of *commutata* often present a grayish appearance, due to a thin but permanent tomentum on both surfaces. The species extends from the coast region of eastern Alaska southward through British Columbia to Oregon, in Alaska not extending west of

Kadiak Island. Mr. Bebb's original specimens were all from the mountains of Oregon and Washington.

The Alaska specimens examined are as follows :

White Pass.—At Log Cabin, Vista, and White Pass, F. A. Walpole, 1900 (Nos. 1066, 1270, 1279).

Glacier Bay.—On the gravels at Muir Glacier, at Hooniah village, Coville and Kearney (Nos. 638, 654), and in Berg Inlet, Kincaid.

Yakutat Bay.—At several points in Disenchantment Bay and Russell Fiord, Coville and Kearney (No. 997), Trelease and Saunders (Nos. 3463, 3464), and on the west side of Yakutat Bay, Coville and Kearney (No. 1118), Fernow.

Prince William Sound.—Incomplete specimens from Port Wells are doubtfully referred here, Coville and Kearney (No. 1274), Trelease and Saunders (No. 3474).

Kadiak Island.—Along a small stream near the summit of the mountain back of Kadiak village, F. A. Walpole, 1900 (No. 1182). Specimens of this willow were brought from a mountain back of English Bay by Miss Harriman, but the specimens unfortunately were not preserved.

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (Nos. 1618, 1680), Trelease and Saunders (No. 3482).

The history of this species, briefly stated, is as follows : In the year 1888 Mr. M. S. Bebb published two closely related new species of willows, *commutata*¹ and *conjuncta*,² which he considered intermediate between *glauca* and *cordata*. Later, in the light of further collections, he recognized and alluded to³ the close relationship of these species with the older *Salix barclayi* of Andersson and his own *Salix californica*.⁴ Still later he described⁵ *barclayi* as a species exhibiting "a degree of variation remarkable even among willows," and was inclined to refer to it as synonymous his *commutata* and *conjuncta*, an inclination to which he afterward yielded as evidenced by his identifications of willows sent to him from the National Herbarium. From the large series of specimens now available and from field observation of these willows in the Cascade Mountains and in Alaska, I do not hesitate to express the opinion that *Salix barclayi* and *Salix commutata* are two valid species, and that *conjuncta* is a synonym of *barclayi*. No botanist with mature leaf specimens of the two plants be-

¹ Bot. Gaz. 13 : 110. 1888.

² Idem, 111.

³ Idem, 16 : 106-7. 1891.

⁴ Bebb in Brewer & Wats. Bot. Cal. 2 : 89. 1880.

⁵ Contr. Nat. Herb. 4 : 198. 1893.

fore him would unite them, but the young leaves of *barclayi* do not always show the glaucous character of their lower surface, and even the characteristic toothling of the margin is then often obscured also. *Salix californica* may be distinguished from *commutata* by its hairy capsules.

9. SALIX PULCHRA Cham. Diamondleaf Willow.

Plate xxxviii.

Salix pulchra CHAM. Linnaea 6: 543. 1831.

Salix phylicoides ANDERS. Oefv. Vet. Akad. Foerh. 15: 123. 1858.

Salix fulcrata ANDERS. Kongl. Vet. Akad. Handl. IV. 6: 139. 1867.

An erect and bushy, though in arctic or alpine situations often prostrate, willow with diamond-shaped leaves bright green and shining above, glaucous beneath, entirely smooth on both surfaces except when very young, usually entire though sometimes sparingly crenate-denticulate near the middle, the stipules lanceolate, glandular-denticulate, and persistent. It is a trim, handsome species, well deserving Chamisso's name *pulchra*. The original description was based on specimens collected by the Kotzebue expedition at Cape Espenberg in Kotzebue Sound and on St. Lawrence Island in Bering Sea. The species ranges from the coast of eastern Siberia through the islands of Bering Sea to Point Barrow on the Arctic coast of Alaska, to Kadiak Island on the south coast, and to the upper Yukon valley in the interior.

The specimens examined are as follows:

Siberia.—On the coast of Bering Sea, between St. Lawrence and Mechigme bays, James T. White, 1894.

Arctic Seacoast of Alaska.—At Point Barrow, John Murdoch, 1882-3.

Kotzebue Sound.—On the Kowak or Putnam River, G. M. Stoney, 1886.

Port Clarence.—On the tundra, often prostrate, sometimes a meter and a half in height, reaching at least 5 cm. in diameter of trunk, Coville and Kearney (No. 1876), Trelease and Saunders (Nos. 3374 to 3376), Brewer and Coe (Nos. 377, 378), Cole.

St. Lawrence Island.—At Northeast Cape, Coville and Kearney (No. 2001), Trelease and Saunders (No. 3445).

St. Matthew Island.—On St. Matthew, Coville and Kearney (No. 2088) Brewer and Coe (No. 466).

Pribilof Islands.—On St. Paul Island, C. Hart Merriam, 1891.

Shumagin Islands.—Common at sea-level on both Popof and Unga, Coville and Kearney (No. 1796a), Trelease and Saunders (Nos. 3453, 3454, 3454a, 3458), C. H. Townsend, 1893.

Kadiak Island.—A common species, Coville and Kearney (No. 1434), Trelease and Saunders (Nos. 3366, 3475), Brewer and Coe (No. 220), Cole, A. Kellogg, 1867 (No. 221, in part), F. A. Walpole, 1900 (No. 1156).

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (Nos. 1633, 1640). On the Nushagak River, C. L. McKay, 1881.

Yukon Valley.—On Fortymile Creek, near its junction with the Yukon, Frederick Funston, 1893 (No. 40). Junction of Allen and Koyukuk rivers, F. C. Schrader, 1899.

Skagway to Lake Bennett.—Collected at various points, F. A. Walpole, 1900 (Nos. 1060, 1061, 1068, 1084, 1085, 1269).

Adelbert von Chamisso, in reporting on the Arctic willows collected by himself and Eschscholtz on the Kotzebue Expedition, describes a willow as follows:

Salix pluries nobis obviam venit, an nova species, pulchra, fruticulosa, depressa, foliis breviter petiolatis pollicaribus majoribusque lanceolatis ellipticisve utrinque acutis integerrimis glabris, subtus glaucescentibus, venis pennatis obliquis tenuibus utrinsecus [utrinsecus] 5-8 notatis, stipulis lineari-filiformibus serratis, amentis lateralibus sessilibus villosis, femineis maturis crassis circiter bipollicaribus, capsulis lanatis subsessilibus. Habitus fere Salicis arcticæ Pall.—In Promontorio Espenbergii Americæ transbeeringiensis, inque insula Sti. Laurentii.—An eadem, quam sterilem prope Tigil Kamtschatcæ occidentalis legit Erman? cui folia majora, latiora, bipollicaria, subinde obovata, venis pluribus primariis utrinsecus 8-10-ornata.¹

This is an excellent description of a certain willow common in western Alaska, and the description applies to no other species of that region. It is therefore assumed, even in the absence of the type specimens, that Chamisso's *Salix pulchra* is identifiable. The species to which the description applies is the *Salix phylicoides* of Andersson,² which was afterward divided by its author so as to make an additional species, *fulcrata*.³ Mr. M. S. Bebb critically investigated the two in 1888 and pointed out their identity, figuring a series of leaves and fruits.⁴ Chamisso's name appears to have been lost sight of, as it is not included in the Index Kewensis, nor is it cited as a published name in any of the works on willows that I have consulted. Andersson alluded to the plant in 1858, when he referred it⁵ dubiously to the *S. lapponum* of Linnaeus, but likened its leaves to those of the European species *phylicifolia*, a willow so nearly resembling our Alaskan plant

¹ Linnaea 6: 543. 1831.

² Oefv. Vet. Akad. Foerh. 15: 123. 1858.

³ Kongl. Vet. Akad. Handl. IV. 6: 139. 1867.

⁴ Bot. Gaz. 13: 186-7. pl. 10. 1888.

⁵ Oefv. Vet. Akad. Foerh. 15: 120. 1858.

that Andersson himself recognized that resemblance in his name *S. phylicoides*.

There is some doubt as to the real type locality of Andersson's *Salix phylicoides*. He said "Hab. in arctica America occidentali (Awatcha Bay: Seeman[n])." Awatcha Bay, however, is not in Alaska but in southern Kamchatka. It is the bay on which the Russian port of Petropavlovsk is situated. The British ship Herald, on which Seemann visited the North Pacific, worked also, however, extensively in Kotzebue Sound and neighboring parts of Arctic Alaska, and it is probable that the type specimens came from that coast.

10. SALIX GLAUCA L. Grayleaf Willow.

Plate XXXIX.

Salix glauca L. Sp. Pl. 2: 1019. 1753.

Salix seemannii RYDBERG, Bull. N. Y. Bot. Gard. 2: 164. 1901.

An erect willow, commonly .5 to 1.5 meters high, with entire leaves glaucous on the lower surface and permanently clothed beneath, and the upper ones usually also above, with a rather thin covering of long appressed hairs, the ovaries white-hairy, and the catkin-scales light brown to straw-colored. The plant was originally described from north European material but the species has a circumpolar distribution. In Alaska it ranges from the shores of Bering Sea eastward to the upper Yukon.

Specimens have been examined as follows:

White Pass.—At Bennett and Vista, F. A. Walpole, 1900 (Nos. 1081, 1275).

Glacier Bay.—On the gravels at the Muir Glacier, very scarce, Coville and Kearney (No. 641a).

Kadiak Island.—One of the commonest willows about Kadiak village, Coville and Kearney (Nos. 1438, 2248, 2328, 2331), Trelease and Saunders (Nos. 3362, 3367, 3477), Cole, F. A. Walpole, 1900 (Nos. 1155, 1157). At Sturgeon Bay, near Cape Karluk, Trelease and Saunders (No. 3368), Brewer and Coe (No. 482).

Shumagin Islands.—Abundant at Sand Point, Popof Island, and on Unga Island, Coville and Kearney (No. 1800), Trelease and Saunders (Nos. 3369 to 3371), Kincaid, M. W. Harrington, 1871-2, C. H. Townsend, 1893.

Bristol Bay.—Near Nushagak, C. L. McKay, 1881.

St. Michael.—On the mainland opposite the island, Frederick Funston, 1894 (No. 236).

Port Clarence.—Along a stream valley in the tundra, Coville and

Kearney (No. 1875), Trelease and Saunders (No. 3373), Brewer and Coe (No. 380).

Kotzebue Sound.—On Chamisso Island, Berthold Seemann, 1848–1850.

In addition to these localities, the plant is reported from the Upper Yukon valley.

There is a tendency among American willow students to exclude *Salix glauca* from the North American flora, but our Alaskan specimens show so close an agreement with some European material of this species that I am unwilling to separate them. A *Salix seemannii* has been described very recently,¹ the type specimen collected at Dawson, Yukon Territory, by R. S. Williams, June 11, 1899. The species is credited also to Kotzebue and Norton sounds, Alaska, on the basis of collections made by Berthold Seemann. No comparison of the differences between *glauca* and *seemannii* is made by the author, nor am I able to find in the description a record of any characters that serve to distinguish the specimens assigned to the latter species from forms of *glauca* found in America and Europe.

11. SALIX NIPHOCCLADA Rydberg. Mouseleaf Willow.

Salix niphoclada RYDBERG, Bull. N. Y. Bot. Gard. 1: 272. 1899.



FIG. 20. *Salix niphoclada* Rydberg: *a*, pistillate flowering twig, natural size; *b*, pistillate flower, enlarged six diameters; *c*, mature leaf, natural size.

An erect bushy willow, at least half a meter in height, the twigs and lower surfaces of the leaves in dried specimens very gray, almost mouse-colored, from their glaucousness and appressed hairs, and the darkening of the tissues in drying. The leaves are oblong-lanceolate to ovate-lanceolate, acute at the apex, rounded or cordate at the base, on petioles 2 mm. or less in length, entire or with a few obsolescent teeth toward the base, commonly 1.5 to 3.5 mm. long, the lower surface very glaucous and, in all except some of the lowermost rudimentary leaves, with a rather sparse, permanent, rather appressed pubescence of somewhat curly hairs, the

upper surface green and with a sparse (except in the upper leaves of vigorous twigs) pubescence of longer appressed hairs like those on the twigs. The slender catkins, about 4 to 6 mm. in diameter, are

¹ Rydberg, Bull. N. Y. Bot. Gard. 2: 164. 1901.

borne on branches of the season which are sometimes 2.5 cm. long and commonly bear 3 to 5 leaves. The catkin scales are pale brown to straw-colored, the ovaries white-tomentose, and the styles from .5 mm. long to almost nothing. The plant is a rare one in herbaria, having been collected, so far as known, only near the mouth of the Mackenzie River in British America (the type locality), on the Porcupine River in Alaska, and on the northwestern shore of Hudson Bay.

The specimens examined are as follows :

Mackenzie River.—At a point 30 miles north of the Arctic Circle Miss E. Taylor, 1892.

Porcupine River.—At its junction with the Yukon, growing along the margins of woods, Frederick Funston, 1894 (No. 185).

Hudson Bay.—Near the mouth of Seal River, 40 miles (64 km.) northwest of Fort Churchill, E. A. and A. E. Preble, 1900 (No. 26). Identified by P. A. Rydberg.

Dr. Rydberg based his description on a single fruiting specimen collected by Miss E. Taylor, as above cited, and deposited in the herbarium of the Geological and Natural History Survey of Canada. Mr. Funston's material is in flower and full leaf, and includes both pistillate and staminate specimens. This additional material necessitates a change in the original description in only minor details, all of which are included in the general characterization given above. The staminate catkins in our specimens are about 1 cm. in length, and except the exerted portions of the stamens, about 3 mm. in diameter, with 2 stamens to each flower, the filaments smooth. The nearest relative of the species among Alaskan willows is *Salix glauca*.

12. SALIX ARBUSCULOIDES Anders. Little-tree Willow.

Salix arbusculoides ANDERS. Kongl. Vet. Akad. Handl. IV. 6: 147. *t. 8. f. 81.* 1867.

Salix humillima ANDERS. in DC. Prod. 16²: 248. 1868.

An erect shrub with reddish stems and narrowly elliptical-lanceolate leaf-blades acute at both ends, smooth and bright green above, glaucous beneath, the margins finely and closely denticulate throughout, the lower surface with a permanent pubescence of straight, closely appressed rather short hairs. The catkins, which appear with the leaves on short usually leafy-bracted peduncles, are cylindrical and slender, the ovaries pubescent. The species was described from specimens collected in eastern British America at Prince Albert Sound and Rae River; the Labrador locality, also assigned the plant in the original publication, is probably an error. None of the types has been accessible to the

writer, and the present reference of our specimens is based on an identification by Herr Rittmeister von Seemen of the Berlin Herbarium.

Our Yukon Valley specimens are as follows:

Fortymile Creek.—Near the junction of Fortymile Creek with the Yukon River, Frederick Funston, 1893 (No. 42a).

Dawson.—"Island near footbridge," R. S. Williams, 1899.

Fiftymile River.—Collected by Arthur L. Bolton, 1899.

Salix arbusculoides most resembles, among Alaskan willows, *Salix sitchensis*, but the toothing and less distinctly oblanceolate character

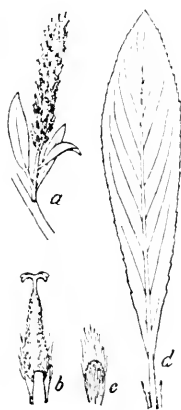


FIG. 21. *Salix arbusculoides* Anders.: a, pistillate flowering twig, natural size; b, pistillate flower, enlarged six diameters; c, scale, same enlargement; d, mature leaf, natural size.

of the leaves, the lack of the permanent satiny lustre of the lower leaf surface, and the presence of two stamens instead of a single stamen in the male flowers, distinguish *arbusculoides*. *Salix sericea* Marsh., of the eastern United States, is another species resembling *arbusculoides* but its leaves are slightly hairy on the upper surface, at least on the midrib, and the apex is acuminate, while the catkins are more densely flowered than those of *arbusculoides*, with the scales usually black, and rather densely villous. In *arbusculoides* the leaves are entirely smooth above, even to the midrib, and the apex is merely acute, the point sometimes blunt; and the catkins are more loosely flowered, the scales light to dark brown, scarcely black, sparingly villous. The willow described by von Seemen in 1895 as *Salix saskatchawana*¹ seems to be closely related to *Salix arbusculoides* but the statement regarding the leaves, "untere Seite in der Jugend fein seidig behaart, im ausgewachsenen Zustande beide Seiten kahl," furnishes the presumption of a specific distinction.

In addition to the flowering specimens collected by Mr. Funston mature leaves and fruit were collected at Dawson, Yukon Territory, June 19, 1899, by Mr. R. S. Williams, and similar mature specimens at Fiftymile River, Yukon Territory, in the same year, by Mr. Arthur L. Bolton. From the upper Yukon the species extends eastward nearly or quite across the northern part of the continent. None of these collectors described the habit of the plant, but it certainly is not a prostrate species, and doubtless is not a tree.

¹ Seemen, Engl. Bot. Jahrb. Beibl. 52: 7. 1895.

13. *SALIX MYRTILLIFOLIA* Anders. Myrtle Willow.

Salix myrtillifolia ANDERS. Oefv. Kongl. Vet. Akad. Föerh. 15: 132. 1858.
Also ANDERS. Proc. Am. Acad. 4: 74. 1858.

A small, trailing, rather than prostrate, willow, the branches often standing erect for a decimeter or two above the ground. The leaf-blades in our specimens are oblong, 1 to 2 cm. in length, broadly acute or obtuse at base and apex, entirely smooth, evenly crenate about the whole margin, on smooth petioles about 1.5 to 3 mm. in length. The catkins appear with the leaves from lateral buds on old wood, the short pubescent peduncles, 1 to 3 mm. in length, bearing usually 2 to 3 small leaves. The pistillate catkins are 1 to 2 cm. in length, and about 4 to 5 mm. in diameter, the scales short, black-tipped, and sparingly hairy. The ovaries are smooth, lanceolate, tapering into a short style .5 mm. or less in length, the pedicel about twice or three times the length of the nectary and only a little shorter than the catkin scales. The species is known only from the interior of British America, the type specimens being marked "Rocky Mountains, east side, low situations." It has been found so close, however, to the Alaskan boundary, namely on the shores of Lake Bennett, Yukon, J. B. Tarleton, 1899 (Nos. 4a, 4b), and below White Horse Rapids, R. S. Williams, 1899, that its occurrence in Alaska may be expected.

From lack of specimens it has been impossible to give this species the critical study it needs, particularly in the direction of establishing its relationship to *Salix pseudomyrsinites* and *Salix curtiflora*. These were published as species by Andersson in the same paper in which *myrtillifolia* was published, but he afterward brought all three together as varieties of his *Salix novaeangliae*, a treatment which has not been followed by recent American students of Salices.



FIG. 22. *Salix myrtillifolia* Anders.: a, pistillate flowering twig, natural size; b, pistillate flower, enlarged six diameters; c, leaf, natural size.

14. *SALIX CHAMISSONIS* Anders. Chamisso Willow.

Salix chamissonis ANDERS. in DC. Prod. 16²: 290 1868.

A prostrate willow with obovate smooth leaves minutely and closely glandular-serrate about the entire margin. It is the only normally prostrate willow of Alaska with glandular-serrate stipules. Its creeping branches and bright green leaves form rather dense patches in moist

places in the tundra. The plant is confined to the truly Arctic zone on the islands and shores of the northern part of Bering Sea, the original specimens having been collected by Chamisso and Eschscholtz, botanists of the Kotzebue Expedition, in 1816, at St. Lawrence Bay, on the Siberian side of Bering Strait, about latitude $65^{\circ} 40'$.

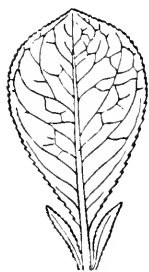


FIG. 23. *Salix chamissonis* Anders., a mature leaf, natural size.

Specimens have been examined as follows:

Port Clarence.—Abundant on the tundra of the mainland at the landing place of the expedition, Coville and Kearney (Nos. 1877, 1878, 1879), Trelease and Saunders (No. 3472), Cole.

St. Lawrence Island.—Found sparingly on the tundra at Northeast Cape, Coville and Kearney (No. 2003). The plant was also collected on this island by Chamisso and Eschscholtz, according to Ledebour, and by Kjellmann, of the Vega Expedition.

Siberian Coast.—Collected at Plover Bay by W. H. Dall, of the Western Union Telegraph Expedition, in 1865-6.

This species is easily distinguishable from the other prostrate willows of Alaska by the form and serration of its leaf-blades. These are commonly 1.5 to 3 cm. in length, narrowly obovate to nearly orbicular, apiculate, broadly acute or rounded at the apex, and either glaucous or shining beneath. The catkins, which stand erect on leafy peduncles, are a centimeter or a little more in diameter and commonly 3 to 6 times as long. In most of the specimens the capsules are distinctly but not densely pubescent, but in some they are smooth. The style is about a millimeter in length.

15. *SALIX ARCTICA* Pallas. Arctic Willow.

Plate XL.

Salix arctica PALL. Fl. Ross. 1²: 86. 1788.

Salix diplodictya TRAUTV. Nouv. Mem. Soc. Nat. Mosc. 2: 307. *t.* 14. 1832.

Salix crassijulis TREV.; TRAUTV. Nouv. Mem. Soc. Nat. Mosc. 2: 308. *t.* 15. 1832.

Salix pallasii ANDERS. in DC. Prod. 16²: 285. 1868.

The commonest and the largest of the prostrate willows of Alaska. Its short half buried trunk is sometimes 2 to 3 cm. in diameter, and sends out stout horizontal creeping branches sometimes a centimeter thick at the base. Its leaf blades are normally about 2.5 to 4 cm. long, obovate, obtuse at the apex, tapering at the base, glaucous beneath, entire, or

very sparingly denticulate toward the base, smooth on both sides at maturity, but usually with some long soft appressed hairs on the margins and lower surface when young. Sometimes, however, the leaf-blades are almost orbicular with a scarcely tapering base, sometimes the apex is acute, sometimes retuse, and in robust specimens they may reach a length of 7.5 cm., often then developing ovate-lanceolate entire stipules. It is the only prostrate willow of Alaska, except *chamissonis*, that produces stipules, and in that species the stipules are glandular-serrate. Occasionally the upper surface of the leaves bears some cobwebby hairs, even till maturity. A conspicuous feature of the plant when growing is the long, erect, stout, hairy catkins standing above the leaves, which look like little cat tails. The catkin scales are usually black, obtuse, and long-hairy, the ovaries densely white-woolly, becoming more thinly tomentose as they expand and mature, and the styles are commonly 1 to 2 mm. in length. The plant is an arctic-alpine species occurring near timber line, or in cold situations at lower elevations, along the southern coast of Alaska from Juneau westward to the Siberian coast, and northward to the coast of the Arctic Ocean. The original specimens of *arctica* were collected by Sujef in Siberia along the Gulf of Obi, of *diplodictya* on St. Lawrence Island, Bering Sea, and of *crassijulis* in St. Lawrence Bay, Siberia.

A large number of specimens have been examined, as follows:

Juneau.—Above Silver Bow Basin, Grace E. Cooley, 1891.

White Pass.—Near the summit, altitude about 3000 feet, Coville and Kearney (No. 518), Trelease and Saunders (No. 3399), R. S. Williams, 1899, F. A. Walpole, 1900 (Nos. 1104, 1109, 1248, 1278).

Glacier Bay.—At various points, Coville and Kearney (Nos. 621, in part, 625, 655), Trelease and Saunders (Nos. 3400, 3401, 3401a, 3402 to 3405, 3407 to 3409, 3433, in part), Brewer and Coe (Nos. 37, 41), Kincaid, Walter H. Evans, 1897 (No. 157). Most of these specimens were collected on the cold glacial gravels near sea level, the timber line belt being deeply covered with snow at the time of our visit.

Takutat Bay.—At various localities, Coville and Kearney (Nos. 1001 to 1003, 1013, 1040, 1076, 1082, 1099, 1140), Trelease and Saunders (Nos. 3410, 3411, 3414, 3411, 3472), Frederick Funston, 1892 (No. 117). Most of these specimens were collected on glacial gravels near sea level.

Prince William Sound.—At several localities, Coville and Kearney (Nos. 1195, 1271, 1362), Trelease and Saunders (Nos. 3416 to 3418). Some of these grew at sea level, others at 2500 feet elevation.

Kadiak Island.—At various points, Coville and Kearney (No. 1472), Trelease and Saunders (Nos. 3419 to 3421), Brewer and Coe (Nos. 206, 232), Cole, Walter H. Evans, 1897 (Nos. 437 to 439), F. A. Walpole, 1900 (Nos. 1168, 1169).

Shumagin Islands.—At several localities on Popof and Unga, Trelease and Saunders (Nos. 3423, 3424, 3456, 3457), Brewer and Coe (No. 280), Kincaid, M. W. Harrington, 1871-2. On Nagai Island, C. H. Townsend, 1893.

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (No. 1670), Trelease and Saunders (No. 3422), Kincaid. At Stepovak Bay, Palache. At Bailey Harbor, Belkofski Bay, C. H. Townsend, 1893. At Nushagak, without collector's name, 1882.

Alutian Islands.—On Akun Island, C. H. Townsend, 1893. On Unalaska, Coville and Kearney (Nos. 1786a, 2200), Trelease and Saunders (No. 3426), Brewer and Coe (No. 296), Cole, H. G. von Langsdorff, 1805-6, A. Kellogg, 1867 (No. 275), M. W. Harrington, 1871-2, L. M. Turner, 1880, C. Hart Merriam, 1891, J. M. Macoun, 1891, B. W. Evermann, 1892, Walter H. Evans, 1897 (No. 537, in part). On Attu Island, J. M. Macoun, 1891, W. V. E. Jacobs, 1894.

Pribilof Islands.—On St. Paul, Robert White, 1879, William Palmer, 1890 (Nos. 310, in part, 425, 724), C. Hart Merriam, 1891, J. M. Macoun, 1892, 1897, C. H. Townsend, 1893, Trevor Kincaid, 1897.

St. Matthew Islands.—On St. Matthew, Coville and Kearney (No. 2086), Trelease and Saunders (Nos. 3394, 3430, 3431, 3447). On Hall Island, Coville and Kearney (No. 2082), Trelease and Saunders (Nos. 3428, 3429, 3446), Brewer and Coe (No. 410), J. M. Macoun, 1891.

Arctic Seacoast.—Collected at Point Hope by some person on the Revenue Cutter Corwin in 1883.

Siberia.—At Plover Bay, Coville and Kearney (No. 1865), Cole, W. H. Dall, 1865-6. On Bering Island, L. Stejneger, 1882-3.

Salix arctica is exceedingly variable in its leaf characters, and this, together with certain nomenclatorial accidents, has caused the species to be known under several different names. Mr. M. S. Bebb published a critical statement on the subject in 1889,¹ based in part on correspondence with Trautvetter, which I have here followed. The large number of specimens examined tends to confirm the idea that the extreme variation in the leaves is chiefly an individual characteristic and does not mark recognizable incipient species. The nearest ap-

¹ Bot. Gaz. 14: 115-17. 1889.

proach I have found to a subspecific differentiation is in some of the specimens from the Pribilof and St. Matthew Islands in Bering Sea, and the Shumagin Islands. In these specimens the leaves are orbicular or nearly so and only about 2 to 3 cm. in diameter, while the catkins are shorter than usual, about 1.5 to 3.5 cm. in length. Occasionally specimens are found which lack the glaucousness of the lower leaf surface, a character on which Trautvetter based chiefly his separation of *diplodictya*.

16. *SALIX GLACIALIS* Anders. Icy Willow.

Salix glacialis ANDERS. Oefv. Vet. Akad. Foerh. 15: 131. 1858.

A prostrate willow with smooth stems and buds, small oval obtuse leaves 12 mm. or less in length, smooth, or when young slightly appressed-villous on the lower surface, glaucous on the back, entire or with a few teeth toward the base, the catkins ovoid to globose, several-flowered, the scales black and nearly smooth on the outside, the ovaries densely white hairy, and the style wanting. Its foliage resembles that of *ovalifolia*, though smaller, but in the pistillate flowers it is very different from any species of the *ovalifolia* group.

The species is known only from the type specimen collected by Lieutenant W. J. S. Pullen, in 1849, on the Arctic seacoast between Point Barrow and the Mackenzie River, and from specimens collected at Point Barrow by John Murdoch, in 1882-3. Staminate specimens and mature leaves are unknown.



FIG. 24. *Salix glacialis* Anders.: a, pistillate flowering twig, natural size; b, pistillate flower, enlarged six diameters.

17. *SALIX FUSCESCENS* Anders. Bog Willow.

Salix fuscescens ANDERS. Kongl. Vet. Akad. Handl. IV. 6: 97. 1867.

A prostrate or trailing willow, with small smooth leaves glossy above, glaucous beneath, of a rhombic-obovate form, the broadest part distinctly above the middle, and usually with a few teeth toward the narrowed base, the ovaries smooth, styles less than half a millimeter in length, and the pedicels two or more times the length of the nectaries. It is a species of western Alaska, occurring from the peat bogs of Kadiak Island and Cook Inlet westward to the tundra of the shores and islands of Bering Sea and the Arctic Ocean, and is found also in eastern Siberia.

Specimens have been examined as follows:

Cook Inlet.—In bogs at Kasilof, Walter H. Evans, 1898 (Nos. 682, 726).

Kadiak Island.—In a bog at the head of a lake about a mile and a half from the village of Kadiak, F. A. Walpole, 1900.

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (No. 1660).

Norton Sound.—At Unalaklik, Frederick Funston, 1894 (No. 232).

St. Lawrence Island.—On the marshy tundra at Northeast Cape, Coville and Kearney (No. 2002), Trelease and Saunders (Nos. 3443, in part, 3444), Cole.

St. Matthew Island.—On the tundra, Coville and Kearney (No. 2087a).

Siberian Coast.—At Plover Bay, W. H. Dall, 1865–6, Coville and Kearney (No. 1856), Cole.

In his original description Andersson gave the range of this species as “in Kamtschatka (Beechy et Mertens), ad Alaxa (Kostalski), ad ostium fl. Uda, ad sinus Manga, Nichta, Ujakon, et in insula Schantar (Middend.),” and he found it also

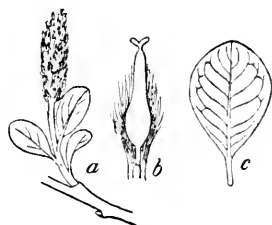


FIG. 25. *Salix fuscescens* Anders.: a, pistillate flowering twig, natural size; b, pistillate flower, enlarged six diameters; c, mature leaf, natural size.

among the Kotzebue plants from Eschscholtz Bay and Shishmaref Bay or Inlet, in Kotzebue Sound. It has been impossible to consult any of these specimens, and our identifications of the species rests on descriptions alone. In Hooker and Arnott's Botany of Captain Beechey's Voyage and various subsequent publications the species was misidentified as *S. rhamnifolia* Pallas. Among the Alaskan species *fuscescens* most nearly resembles *ovalifolia*, but may readily be distinguished by the characters given in the

key. Its nearest relative among North American willows is *Salix myrtilloides* L., a circumpolar species occurring on our continent chiefly on the eastern side, in bogs, and apparently not extending northwestward to Alaska. The name *fuscescens* was given to the plant to indicate the tendency of the young leaves to turn blackish in drying, a phenomenon characteristic, however, of several other species of willows.

18. *SALIX OVALIFOLIA* Trautv. Oval Willow.

Salix ovalifolia TRAUTV. Nouv. Mem. Soc. Nat. Mosc. 2: 306. t. 13. 1832.
Salix unalascensis CHAM.; ANDERS. Oefv. Kongl. Vet. Akad. Foerh. 15: 130. 1858.

Salix rotundata RYDBERG; JORDAN, Fur Seal Islands 3: 571. 1899, not
Salix rotundata FORBES 1829.

Salix cyclophylla RYDBERG, Bull. N. Y. Bot. Gard. 1: 274. 1899.

A common and characteristic prostrate willow of western Alaska and eastern Siberia, extending in Alaska along the coast from the Shumagin Islands westward to the Aleutian Islands, northward through the islands and shores of Bering Sea, and northeastward along the Arctic Ocean to Point Barrow. The type specimen of *ovalifolia* came from Cape Espenberg, Kotzebue Sound, of *unalascensis* from Unalaska, of *rotundata* and *cyclophylla* from St. Paul Island, of the Pribilof group. It is distinguishable from the other prostrate willows of Alaska by its oval to orbicular, nearly or quite entire leaves usually 10 to 20, or sometimes even 25, mm. in length, glaucous beneath, and at maturity thick, tough, and prominently marked beneath by a net-work of fine veins, its slender shoots of the season running over the surface of the ground, its smooth and glaucous capsules on stalks little or not at all exceeding the nectaries, and its styles about .5 mm. in length. It forms large carpet-like patches in the grass, extending to sea level, apparently, in the southernmost parts of its range and reaching therefore below the limits of most strictly arctic plants.

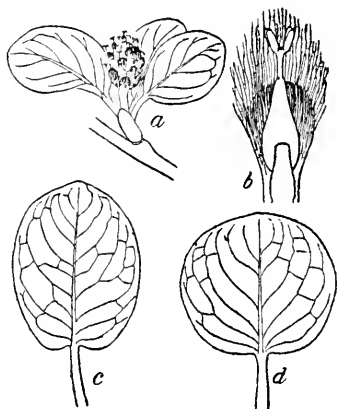


Fig. 26. *Salix ovalifolia* Trautv.: a, pistillate flowering twig, natural size; b, pistillate flower, enlarged six diameters; c, d, mature leaves, natural size.

Specimens have been examined as follows:

Takutat Bay.—On the glacial gravels along the west shore of the bay, only a single patch seen, Coville and Kearney (No. 1141). Although this locality is far to the east of the main range of the species, the specimens have the characteristic long creeping shoots and glaucous capsules. The fact that only a single patch was observed, close to the bank of a stream, suggests that a stray seed may have been brought to the spot by the wind or some water bird. It is quite possible, too, that *Salix ovalifolia* occurs at several points east of Kadiak, for the

limited character of the collections thus far made in Cook Inlet and Prince William Sound do not preclude the possibility of its occurrence in those places.

Kadiak Island.—Mountain back of Kadiak village, F. A. Walpole, 1900 (No. 1227).

Alaska Peninsula.—Collected in Stepovak Bay, where it was rather abundant, Palache.

Shumagin Islands.—At Sand Point, Popof Island, Coville and Kearney (No. 1799), and elsewhere on the same island, Trelease and Saunders (No. 3425).

Pribilof Islands.—Abundant and forming large mats near the village of St. Paul, St. Paul Island, Coville and Kearney (No. 1837), Trelease and Saunders (No. 3442), Kincaid, Cole, Brewer and Coe (Nos. 325, 329), Mrs. Bryant, 1875, William Palmer, 1890 (Nos. 353, 424, 556), C. H. Townsend, 1893, J. M. Macoun, 1897.

St. Matthew Islands.—On St. Matthew Island, Coville and Kearney (No. 2087), Trelease and Saunders (No. 3448), Brewer and Coe (No. 469). On Hall Island, Coville and Kearney (Nos. 2084, 2085).

St. Lawrence Island.—At Northeast Cape, Trelease and Saunders (No. 3443), Cole.

Point Barrow.—Collected by John Murdoch, 1882-3 (No. 65).

Siberian Coast.—At Kayne, or Arakamtchechene, Island, collected on the Ringgold and Rodgers U. S. North Pacific Exploring Expedition, C. Wright, 1853-6.

Various other collections of the plant have been made about Bering Sea and north of Bering Strait along the Arctic coast of Alaska, the easternmost record, between Point Barrow and the Mackenzie River, resting on a specimen collected by Lieutenant W. J. S. Pullen, in 1849.

The name *Salix unalaschcensis* which is often cited as published by Chamisso in 1831,¹ can not properly, it seems to the writer, be cited as of that date, the word *unalaschcensis* being merely the first word in a Latin note on a willow to which Chamisso did not give a name. In another precisely similar case he began "*Salix ad portum Sancti Francisci*." It evidently did not occur to Ledebour that the word had any nomenclatorial intent or value for he did not cite it in his *Flora Rossica*. The first use of *Salix unalaschcensis* in such a way as to give it standing in nomenclature appears to be Andersson's citation of it in 1858, as given above. He at that time referred it doubtfully to the plant we now know as *Salix fuscescens* Anders. Later, in 1868,² he referred it to *Salix ovalifolia*, the species, and the

¹Cham. *Linnaea* 6: 541. 1831.

²Anders. in DC. *Prod.* 16²: 291. 1868.

only species, with which Chamisso's description agrees. Dr. Rydberg's recent application of Chamisso's name *unalaschcensis* to a prostrate willow of the Juneau district of eastern Alaska is discussed under *Salix stolonifera*.

Dr. Rydberg's *Salix rotundata*, a homonym for which he afterward substituted the name *Salix cyclophylla*, as cited above, I am unable to distinguish from *ovalifolia* except as a common, and perhaps indeed the prevalent, form with orbicular instead of oval leaves. Both forms of leaves occur sometimes on the same plant, and all the other characters that distinguish the oval-leaved *ovalifolia* from other willows are found also in the orbicular-leaved plant.

19. SALIX STOLONIFERA Coville. Sprouting Willow:

Plate XLI, Figure 1.

***Salix stolonifera* sp. nov.**

Plant prostrate; branches of the season smooth, 1 to 2 mm. in diameter, the underground portions of old stems frequently developing slender subterranean ascending branches or stolons, usually less than a millimeter in diameter; leaf blades commonly 1.5 to 3 cm. long, oval to obovate, rounded or sometimes broadly acute at the apex, either wedge-shaped or rounded at the base, sparingly provided when young with a few early deciduous long straight hairs on the margins and back, entire or with a few teeth near the petiole, glaucous beneath and the reticulations not very conspicuous; catkins terminating leafy branches of the season, oblong to cylindrical; scales black, obovate, rounded at the apex, rather sparingly provided on both surfaces with long straight white hairs inclined to be deciduous; stamens two to each scale, the filaments smooth; ovary smooth or with some traces of pubescence toward the apex, lanceolate, its stalk shorter than the nectary, the style 1.5 to 2 mm. long, each of the stigmas bifid into two linear segments; capsule not glaucous.

Type specimens in the United States National Herbarium, collected June 10, 1900, at the railway station of Glacier, between Skagway and White Pass, Alaska, by F. A. Walpole (No. 1075).

The nearest relative of *Salix stolonifera* in Alaska is *Salix ovalifolia*. The characteristic of the production of slender, leafless, subterranean branches or stolons, which the specimens of *stolonifera* usually show, I have never detected in *ovalifolia*. The length of the styles is perhaps the easiest diagnostic character for one not familiar with the two species. The leaves of *stolonifera* while similar in form

and size to those of *ovalifolia* have the reticulations of the veins much less conspicuous on the back at maturity, and the capsules of *stolonifera* are not glaucous. *Salix ovalifolia* is a characteristic species of the Bering Sea and Alaska Peninsula region, though found sparingly to the eastward as far as Yakutat Bay, while *stolonifera* is a species of eastern Alaska, in the glacier region from Yakutat Bay to Glacier Bay and Lynn Canal.

Stolonifera is evidently the species to which Dr. Rydberg has recently applied, mistakenly as I believe, the name *unalaschensis* of Chamisso.¹ From the original description of Chamisso² the following characters of *unalaschensis* are abstracted: plant prostrate, with branches a foot long; leaves obovate, subglaucous beneath, entire (this last character drawn by inference from Chamisso's comparison of his plant with *Salix arctica* Pall.); ovaries smooth. This would identify the plant with *ovalifolia*, or *fuscescens*, or *stolonifera*. The additional character "stylo elongato" excludes *fuscescens*, and it is doubtless this same phrase that led Dr. Rydberg to identify Chamisso's plant with the very long-styled *stolonifera*. But as *stolonifera* is not known within more than a thousand miles of Unalaska, as the long creeping branches are characteristic of *ovalifolia*, while they are not characteristic of *stolonifera*, and as "elongated" is a relative term, it is reasonable to conclude that Chamisso had in hand not *stolonifera* but *ovalifolia*. For further remarks on the name *Salix unalaschensis*, see the account of *Salix ovalifolia*.

Specimens of *stolonifera* have been examined as follows:

Juneau.—From the mountains above Silver Bow Basin, Grace E. Cooley, 1891. From the mountains east of Juneau, at an altitude of 2500 to 3000 feet, F. A. Walpole, 1900 (Nos. 1232, 1242).

White Pass.—From the summit of White Pass, about 3000 feet altitude, R. S. Williams, 1899, F. A. Walpole, 1900 (No. 1249), and at the railway station of Glacier, between Skagway and White Pass (No. 1075).

Glacier Bay.—On the gravel deposits near the foot of Muir Glacier, Coville and Kearney (Nos. 621a, 627), Trelease and Saunders (Nos. 3433, in part, 3434, 3435, in part, 3437, 3439, 3449 to 3452), Brewer and Coe (No. 51), Walter H. Evans, 1897 (No. 158).

Yakutat Bay.—Near Hidden Glacier, Trelease and Saunders (Nos. 3412, 3413). At Hubbard Glacier, Coville and Kearney (No. 1079).

¹ Rydberg, Bull. N. Y. Bot. Gard. 1: 275. 1899.

² Cham. Linnaea 6: 541. 1831.

20. SALIX POLARIS Wahl. Polar Willow.

Salix polaris WAHL. Fl. Lap. 261. t. 13. 1812.

A very small prostrate willow with stems imbedded in the ground, oval to orbicular-ovovate, entire or nearly entire, smooth, deciduous leaves bright green on both surfaces or somewhat glaucous beneath, commonly 1 to 1.5 cm. long, the oblong to globose pistillate catkins few-flowered, with pubescent or partly smooth ovaries and capsules. It resembles in size and general appearance both *leiocarpa* and *phlebophylla*, but it has shorter catkins than the latter and lacks its persistent skeletonizing leaves. These organs too are less tapering at the base in *polaris* and seem to be wholly devoid of the long hairs often present on the margins in *phlebophylla*. In its slender naked stoloniform stems, imbedded in the ground and rooting, it resembles *leiocarpa*, but that species has smooth capsules and its leaves are smaller and more uniformly orbicular, never glaucous on the back, and inclined to be persistent. In the Alaskan region the species, so far as known, is confined to the Arctic zone, about the shores of the northern part of Bering Sea. It was described originally from Lapland and afterward found in northern Asia.

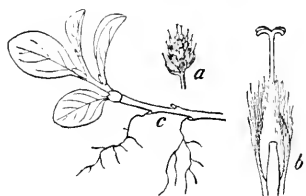


FIG. 27. *Salix polaris* Wahl.: a, pistillate catkin, natural size; b, pistillate flower, enlarged six diameters; c, leafy branch, natural size.

The following specimens, in addition to European ones, have been examined:

Port Clarence.—On the tundra, Trelease and Saunders (No. 3387, 3385, in part). Reported by Lundstrom also as collected here by the Vega Expedition.

Siberian Coast.—On Kayne, or Arakamtchechene, Island, collected on the Ringgold and Rodgers U. S. Exploring Expedition, C. Wright, 1853-6.

Cape Vancouver.—Collected by J. M. Macoun, 1891.

Our specimens of this plant are few and not sufficiently ample to furnish a comprehensive idea of the form of the leaves and the character of the fruit in Alaskan *polaris*. This species was reported from Alaska by several of the early expeditions but it is probable that most if not all these early collections were either *leiocarpa* or *phlebophylla*. Mr. M. S. Bebb in preparing the list of North American willows for

Patterson's Checklist in 1892 omitted *Salix polaris*. Our material, however, though fragmentary and unsatisfactory, makes it probable that the species should again be considered a member of the North American flora. Dr. Rydberg has already taken this view by identifying Mr. Macoun's Cape Vancouver specimen as *Salix polaris*.

21. *SALIX PHLEBOPHYLLA* Anders. Skeleton Willow.

Salix buxifolia TREV.; TRAUTV. Nouv. Mem. Soc. Nat. Mosc. 2: 301. t. 10. 1832, not SCHLEICH. 1815.

Salix arctica minor LEDEB. Fl. Ross. 3: 619. 1849-51, not *Salix arbuscula minor* LAEST. 1845.

Salix phlebophylla ANDERS. Oefv. Kongl. Vet. Akad. Foerh. 15: 131. 1858.

Salix palaeoneura RYDBERG, Bull. N. Y. Bot. Gard. 1: 267. 1899.

A handsome little willow growing in mats on the ground, well distinguished from other Alaskan willows by the characters given in the key. As in *leiocarpha*, the bright green leaves are covered on both

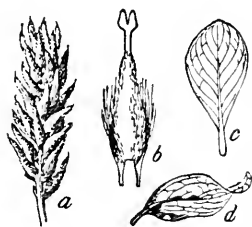


FIG. 28. *Salix phlebophylla* Anders.: a, fruiting catkin, natural size; b, pistillate flower, enlarged six diameters; c, leaf, natural size; d, old leaf, skeletonized, natural size.

surfaces with minute light-colored dots, visible under a lens, each of which marks the position of a breathing pore. The ovaries and capsules are usually pubescent, though sometimes specimens are found in which nearly the whole surface is entirely smooth. The venation of the leaves is striking. On each side of the midrib are from 3 to 6 conspicuous nerves nearly parallel with the margin but running into it toward the apex. These principal nerves are connected with each other by several cross nerves. After the growing season the leaves die but remain attached to the stems, the tissue between the nerves of the leaf becoming trans-

lucent, and by the third season waste away, leaving the skeletonized framework to clothe and protect the stems for several years. In *leiocarpha* the nerves are equally conspicuous but the leaves are not very persistent after the second season and they do not so regularly become skeletonized. The stems of *phlebophylla* are stouter than those of *leiocarpha*, are less completely imbedded in the soil, and do not so often form stolons. The plant grows on the tundra, and occurs along probably the whole Arctic coast of Alaska from the British boundary to Kotzebue and Norton sounds.

Specimens examined.

Siberian coast.—On Kayne, or Arakamtchechene, Island, collected

by the Ringgold and Rodgers U. S. North Pacific Exploring Expedition, C. Wright, 1853-6.

Port Clarence.—On the tundra of the mainland at sea level, Coville and Kearney (No. 1873), Trelease and Saunders (Nos. 3385, in part, 3386, 3388, 3389), Brewer and Coe (No. 379).

Point Barrow.—At sea level, John Murdoch, 1882-3 (Nos. 6, 97).

Porcupine River.—Without special locality, J. H. Turner, 1891.

Under the names *Salix retusa* L. and *Salix anglorum* Cham. this willow has been reported from St. Lawrence Island in Bering Sea, St. Lawrence Bay on the Siberian side of Bering Strait, from Chamisso Island and other points in Kotzebue Sound, and from Pelly Isle at the mouth of the Mackenzie.

S. phlebophylla was published by Andersson in 1858 through the citation of an earlier published description, namely, that given under the name *Salix retusa* by Hooker, Fl. Bor. Am. 2: 153. 1838-9. Hooker cited two specimens, one collected in Kotzebue Sound, Alaska, by the botanists of Captain Beechey's expedition, the other on the Arctic seashore of British America by Richardson. A misunderstanding of the species *phlebophylla* on the part of some authors, has been occasioned by the fact that Andersson referred to *phlebophylla* other specimens which did not in reality belong to the plant described by Hooker as "a very distinct and beautiful species, with glossy, strongly nerved, perennial leaves, the skeleton nerves remaining in the lower parts of the stem." Andersson further complicated the matter when he separated his complex *phlebophylla* into three forms, by describing each of them as having "capsulae glaberrimae." Both these mistakes, however, were corrected by Andersson ten years later, when he described *phlebophylla* as having "capsulis . . . tenuiter puberulis" and "foliis coriaceis nitidis sub lente punctulatis . . . utrinque nervoso-costatis, tertio anno in reticulum cancellatum ob parenchyma evanescens solutis."¹ By these means Andersson clearly restricted the use of the name *phlebophylla* to the plant to which I have here applied it. Dr. P. A. Rydberg has recently² referred to *phlebophylla* several specimens of willow with the lower surface of the leaves glaucous. These do not belong to the skeleton-leaved species with which we are now dealing, and this latter plant being therefore apparently left without a name Dr. Rydberg described it as *Salix palaconeura*,³ basing his description on specimens

¹ Anders. in DC. Prod. 16²: 290-91. 1868.

² Rydberg, Bull. N. Y. Bot. Gard. 1: 275. 1899.

³ Rydberg, Bull. N. Y. Bot. Gard. 1: 267. 1899.

collected at Point Barrow by Murdoch. This disposal of the name *phlebophylla* and the consequent redescription of the skeleton-leaved plant under the name *palaconeura* is clearly inadmissible for the reasons given above, and furthermore because the specimen in the Columbia University Herbarium marked "No. 96 Herb. H[ooker]," which Dr. Rydberg has cited as the type of *phlebophylla*, although a mere fragment consisting of a fruiting catkin and a single leaf, is identical with our skeleton-leaved plant.

It is of interest to note that Trautvetter in his original description of this plant under the name *buxifolia*, the type of which came from St. Lawrence Island, Bering Sea, calls attention particularly to the skeletonizing of the old leaves: "Folia . . . anno primo haud articulis solvuntur, sed marcescunt, fusca evadunt, quo statu per secundum annum plantae adhaerent, tertio vero foliorum parenchyma evanescit reteque venosum cancellatum foliorum plures adhuc annos persistit . . . Species foliis edurantibus notabilis."¹

The name *Salix anglorum* Cham.² has sometimes been used for this species because the specimens of Chamisso and Eschscholtz identified as *Salix anglorum* by Chamisso are identical with Andersson's *phlebophylla*. Dr. Rydberg has pointed out,³ however, that Chamisso did not describe the species but cited Robert Brown's *Salix arctica*, a species of eastern Arctic America to which the name *anglorum* must therefore attach.

A plant which has sometimes been confused with *phlebophylla*, but which is readily distinguishable by its promptly deciduous leaves, often glaucous beneath, is referred to in the present paper under the name *polaris*.

22. SALIX LEIOCARPA (Cham.) Coville. Least Willow.

Plate XLI, Figure 2.

Salix polaris leiocarpa CHAM. Linnaea 6: 542. 1831.

Salix rotundifolia TRAUTV. Nouv. Mem. Soc. Nat. Mosc. 2: 304. t. II. 1832.

This charming little plant is the smallest of the Alaskan willows. It forms close tufts or cushions, the very slender stoloniform stems imbedded in the soil, and the leaves, orbicular, smooth, entire, bright green on both surfaces, from a few millimeters to a centimeter in diameter, rising a centimeter or two above the surface. The type

¹ Trautv. Nouv. Mem. Soc. Nat. Mosc. 2: 302-303. 1832.

² Cham. Linnaea 6: 541. 1831.

³ Rydberg, Bull. N. Y. Bot. Gard. 1: 266. 1899.

specimens of *leiocarpa* were collected on the island of Unalaska and at St. Lawrence Bay, Siberia, about latitude $65^{\circ} 40'$. It grows on the islands and both shores of Bering Sea and the Arctic Ocean, and above timber line on the Pacific coast of Alaska eastward to Prince William Sound, preferring not a wet soil, like most willows, but a well drained humus intermixed with finely broken rock. The little pistillate catkins, barely projecting from the tuft of leaves at the ends of the stems, bear commonly 2 to 4, or occasionally 6 to 8 flowers, the ovaries and capsules entirely smooth.

The specimens examined are as follows :

Prince William Sound.—Above timber line on the large, partly forested nunatak of the Columbia Glacier, Coville and Kearney (No. 1364).

Kadiak Island.—Above the alder line on a mountain back of English Bay, Coville and Kearney (No. 1475), F. A. Walpole, 1900 (No. 1226).

Shumagin Islands.—Popof Island, from 800 to 1500 feet elevation, Trelease and Saunders (No. 3380), Kincaid, and at similar elevations on Unga Island, Trelease and Saunders (No. 3379).

Aleutian Islands.—At Unalaska, J. M. Macoun, 1891. Part of Chamisso's type material was also collected here. Doubtless all the Unalaskan specimens were collected at a considerable elevation above sea level. On Atka Island, L. M. Turner, 1880, where it is a common plant among the patches of crowberry (*Empetrum nigrum*).

St. Matthew Island.—On well drained slopes of rock-weathered soil close to the level of the sea, Coville and Kearney (No. 2154), Trelease and Saunders (Nos. 3383, 3384), Brewer and Coe (No. 476). In similar situations on Hall Island, Coville and Kearney (No. 2083), Trelease and Saunders (Nos. 3081, 3082), Brewer and Coe (No. 438).

Point Barrow.—Near sea level, John Murdoch, 1882-3 (No. 24).

Siberian Coast.—Collected at Kayne, or Arakamtchechene, Island by the Ringgold and Rodgers U. S. North Pacific Exploring Expedition, C. Wright, 1853-6.

On the Asiatic side of Bering Sea the plant has been found at St. Lawrence Bay as already noted, and was collected on the Russian island of Karaginski by Mertens, the botanist of Lutke's voyage, in the years 1826-9. Ledebour in his *Flora Rossica* reports several localities in the inland parts of eastern Siberia. It is probable also that some of the specimens heretofore reported from Bering Sea and the adjacent coast of the Arctic Ocean under the name *Salix polaris* Wahl. belong

to this species. The type locality of Trautvetter's *rotundifolia* is given as St. Lawrence Island.

The nearest Alaskan relative of *Salix leiocarpa*, as indicated in the key, is *Salix phlebophylla* to which the student is referred for further comments on the peculiarities of this little group of species. *Salix polaris* also is a near relative. *Salix behringica* Seemen, recently described¹ from a specimen collected at "Lutke-Hafen,"² near Bering Strait, agrees in most respects with this species. Its leaves, however, are larger, 10 by 14 mm., and it is described as having an erect bushy growth. The specimen on which the description was based was a pistillate twig 17 cm. in length.

23. SALIX RETICULATA L. Netleaf Willow.

Plate XLII.

Salix reticulata L. Sp. Pl. 2: 1018. 1753.

Salix orbicularis ANDERS. in DC. Prod. 16²: 300. 1868.

A prostrate willow very distinct in its characters, as given in the key, from any other Alaskan willow. Its filaments, in the staminate catkins, have their basal portion densely pubescent; in all other Alaskan willows the filaments are glabrous throughout. The scales of the pistillate catkins are broadly deltoid-obovate, dark, or sometimes pale, red-purple in color, smooth on the outside, or slightly hairy at the base, pubescent with short curled hairs on the inside, these hairs projecting only slightly beyond the end of the scale. In most willows the hairs on the catkin scales are long, straight and silky, commonly equaling the scale in length. Usually the leaves at maturity are entirely devoid of hairs, but sometimes, notably in the specimens from the St. Matthew Islands, the long, straight silky hairs frequently present on young leaves persist on both surfaces till the leaves are full grown, usually disappearing in age. The species is widely distributed in North America in arctic and arctic-alpine situations and occurs also in Asia and Europe. In Alaska it stretches over the Arctic zone, except in the extreme north, and southward it occurs at timber line on the mountains from the Juneau region to Kadiak Island, and westward to the Aleutian Islands.

Alaskan specimens have been examined as follows:

Juneau.—Near the summit of the mountains east of Juneau, at an elevation of 3000 feet, F. A. Walpole, 1900 (No. 1233).

¹ Seemen, Engl. Bot. Jahrb. Beibl. 52: 6. 1895.

² Lutke Harbor, I am informed by the Rev. Sheldon Jackson, general agent of education in Alaska, is the anchoring place for vessels behind the sandspit in St. Lawrence Bay, Siberia.

White Pass.—At an altitude of about 3,000 feet, F. A. Walpole, 1900 (No. 1110). At Lake Bennett, J. B. Tarleton, 1899 (No. 15).

Tukon River.—At Coal Creek Hill, Frederick Funston, 1893 (No. 143).

Glacier Bay.—At various points near sea level, Coville and Kearney (No. 669), Trelease and Saunders (Nos. 3395, 3435, in part, 3436, 3438, 3440), Brewer and Coe (No. 49).

Takutat Bay.—Near Hidden Glacier, Trelease and Saunders (No. 3441, in part).

Prince William Sound.—At timber line at Orca, elevation about 2500 feet, Coville and Kearney (No. 1192).

Cook Inlet.—Between Cook Inlet and the Tanana River, E. F. Glenn, 1899.

Kadiak Island.—On the mountain back of Kadiak village, Trelease and Saunders (No. 3396), Coville and Kearney (No. 2312), Cole, F. A. Walpole, 1900 (No. 1181). Mountains back of English Bay, Coville and Kearney (No. 1455). At Sturgeon River, Coville and Kearney (No. 2280). Without special locality, C. H. Townsend, 1888.

Alaska Peninsula.—At Kukak Bay, Coville and Kearney (Nos. 1490, 1537), Trelease and Saunders (No. 3390), Kincaid.

Shumagin Islands.—On Popof Island, Kincaid. Also specimens of M. W. Harrington, 1871-2, probably collected on these islands.

Aleutian Islands.—Unalaska, Coville and Kearney (No. 2199), Trelease and Saunders (No. 3397), B. W. Evermann, 1892 (No. 156), Attu Island, J. M. Macoun, 1891.

Pribilof Islands.—On St. Paul Island, William Palmer, 1890 (No. 310, in part), C. Hart Merriam, 1891, Kincaid, 1897.

St. Matthew Islands.—On St. Matthew, Coville and Kearney (Nos. 2089, 2147, 2177), Trelease and Saunders (No. 3393), Brewer and Coe (No. 465). On Hall Island, Coville and Kearney (No. 2081), Trelease and Saunders (Nos. 3391, 3392).

Cape Vancouver.—Collected by J. M. Macoun, 1891.

Port Clarence.—On the tundra, Coville and Kearney (No. 1872), Trelease and Saunders (No. 3398), Brewer and Coe (Nos. 377a, 396). At the Reindeer Station, James T. White, 1894.

Reported at various points on the Arctic seacoast of Alaska but not beyond Cape Lisburne.

Andersson in 1868, as cited in the synonymy, gave to the east Siberian and Alaskan representative of the circumpolar arctic and arctic-alpine *Salix reticulata* the distinguishing name *Salix orbicu-*

laris, and Dr. Rydberg in taking up this name¹ extends the range of the species across the continent, and states that he has seen no typical specimens of *Salix reticulata* from North America. The distinguishing characters assigned by Andersson are the yellowish rose-colored catkin scales and elliptic-rotund, oval-rotund, elliptic-obovate, or oblong leaves of *reticulata* and the fuscous scales and suborbicular, or obovate-orbicular leaves of *orbicularis*. He says also of the latter species, "Truncus longissime serpit ramulos subvillosos radiciformes undique emittens," and, "A formis vulgaribus *S. reticulatae* habitu abunde diversa." Of these leaf characters it may be said that we have specimens with oblong leaves from Alaska, and specimens with orbicular leaves from northern Europe, and Dr. Rydberg, although maintaining the species to be distinct, says, "The two cannot be distinguished by the leaves." Our Alaska collection contains specimens with pale rose-colored scales, and we have European specimens with dark purple scales. As for habit character, we have specimens from Alaska, collected in drier situations than usual, with branches just as short and rootless and congested as any of those from Europe. An equal lack of constancy is found in the distinguishing characters assigned by Dr. Rydberg. Our specimens of European *reticulata* have bracts not "oblong" but broadly obovate, and instead of being "densely woolly" they are rarely hairy over the entire surface and are often smooth throughout. The size of the capsule and the density of its hairy covering appear to be correlated not with the continental origin of specimens but with the degree of maturity of the capsule itself. While European as well as American specimens show much variation among themselves, I am unable, from the material now available, to see in our American plant a species distinct from the European.

Andersson in 1868 published a *Salix venusta*² from Sitka, the description of which suggests that the plant may prove to be a form of *Salix reticulata* grown in a shaded situation. It is described as differing from *reticulata* in its long styles and its leaves bright green on both sides though somewhat paler beneath. It is very desirable that the plant be again collected. It should be looked for on Mount Vershovia.

¹ Rydberg, Bull. N. Y. Bot. Gard. 1: 260. 1899.

² Anders. in DC. Prod. 162: 288. 1868, not Host. 1828.

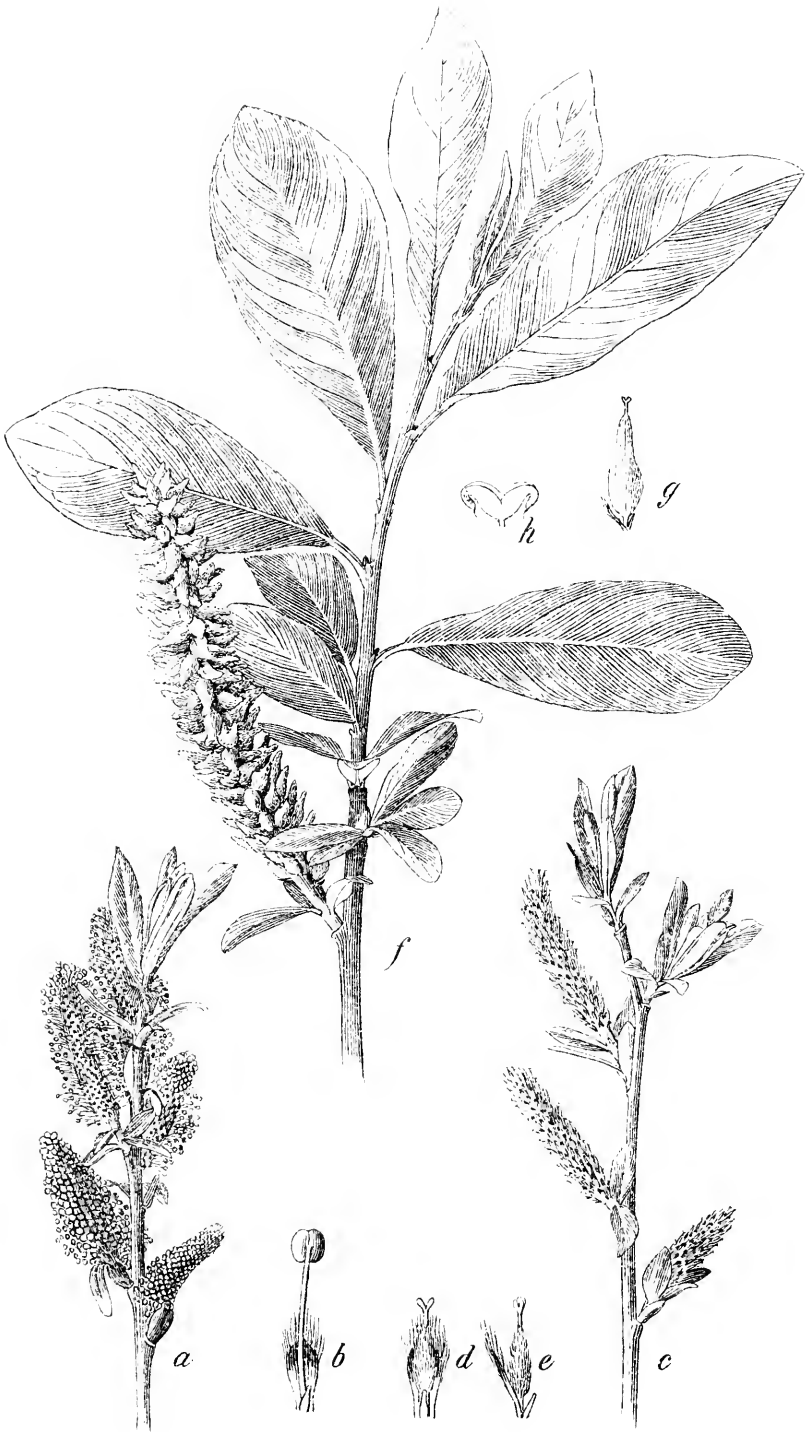
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PLATE XXXIII.

Salix sitchensis Sanson.

- FIG. *a.* Staminate flowering branch, natural size.
b. Staminate flower, showing the nectary, scale, and the single stamen, enlarged six diameters.
c. Pistillate flowering branch, natural size.
d. Pistillate flower viewed from above, enlarged six diameters.
e. Same, lateral view.
f. Fruiting branch, with mature foliage.
g. Capsule, viewed from the side, showing dried scale and nectary, enlarged two diameters.
h. Capsule, split open in dehiscence, enlarged two diameters.

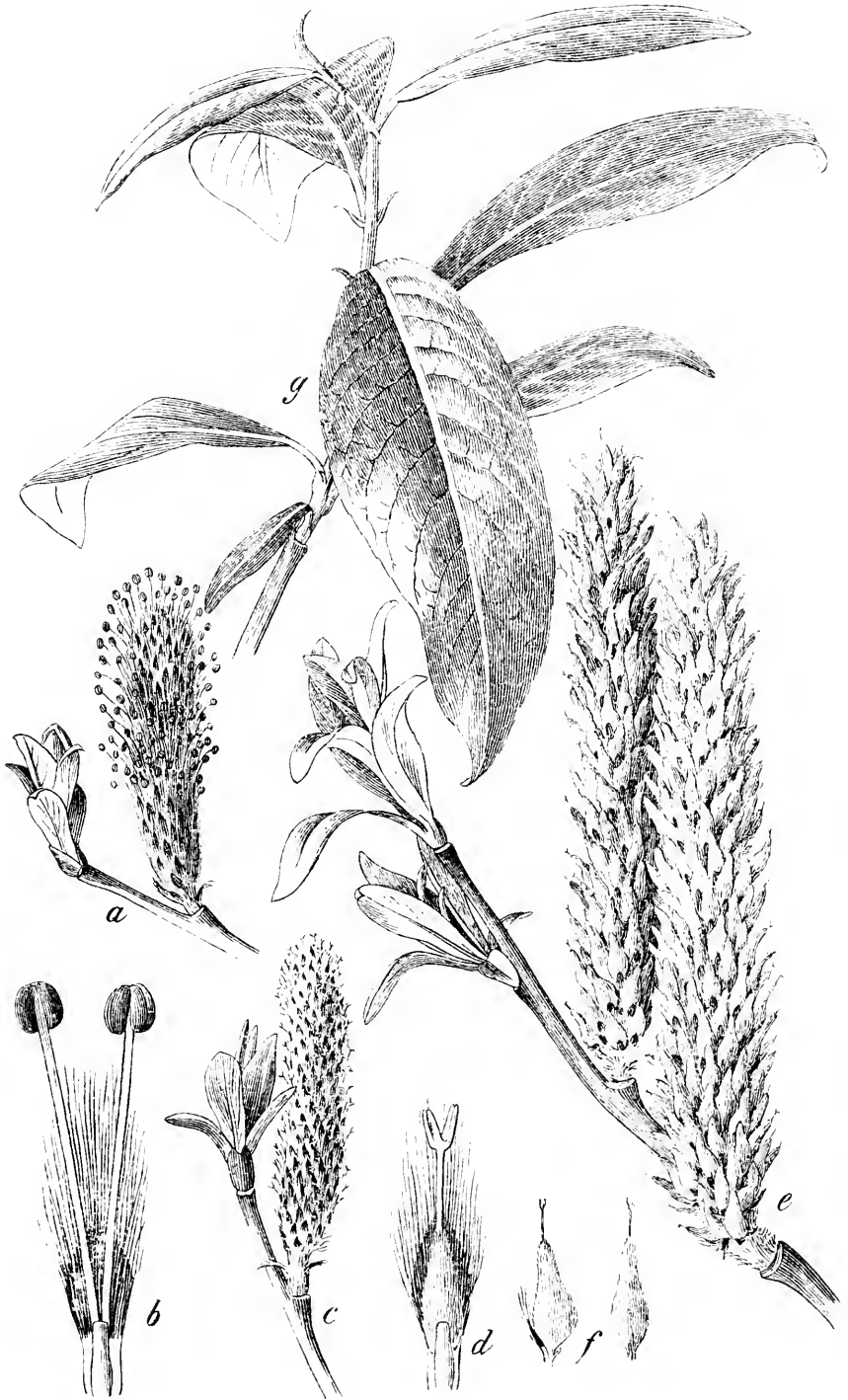


SALIX SITCHENSIS

PLATE XXXIV.

Salix alaxensis (Anders.) Coville.

- FIG. *a.* Staminate flowering twig, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering twig, natural size.
d. Pistillate flower, viewed from above, enlarged six diameters.
e. Branch with nearly mature catkins, natural size.
f. Capsule, two views, enlarged two diameters.
g. Leafy branch, natural size.

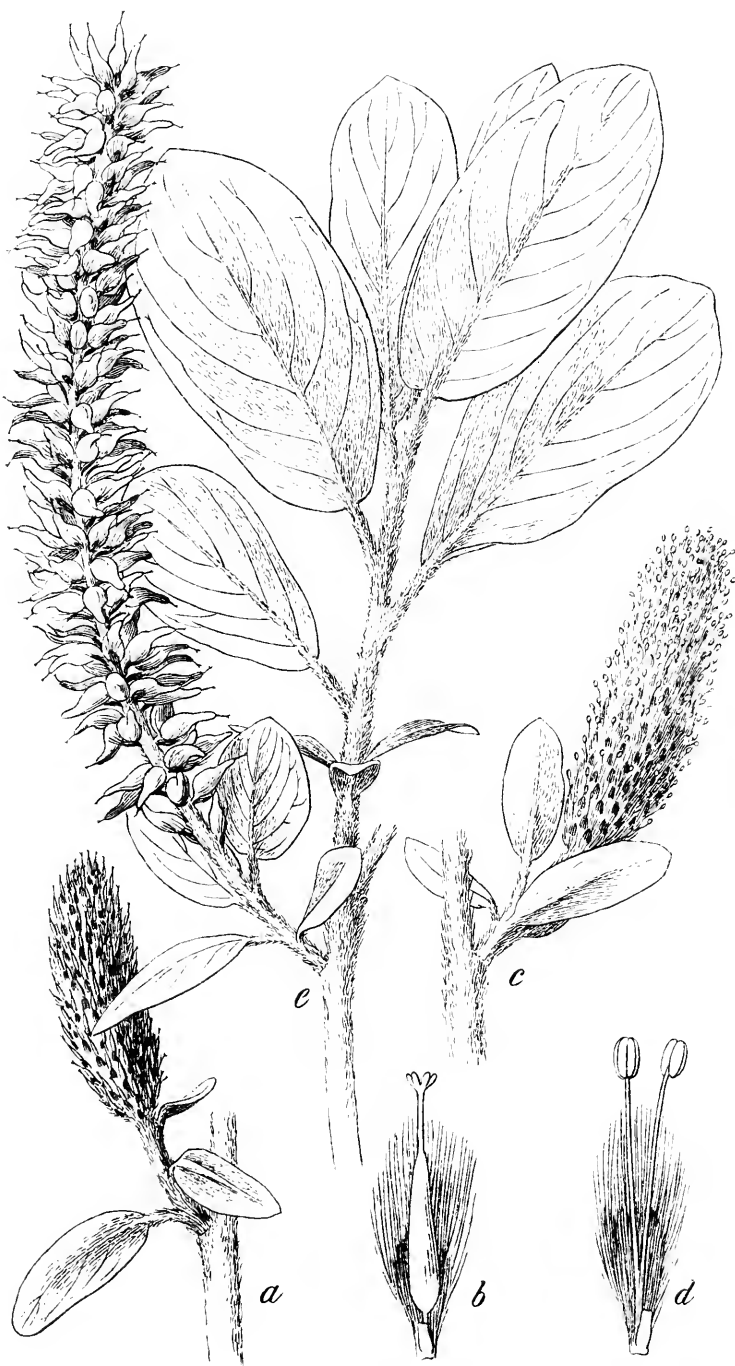


SALIX ALAXENSIS

PLATE XXXV.

Salix amplifolia Coville.

- FIG. *a.* Pistillate flowering twig, seven-eighths natural size.
b. Pistillate flower, enlarged five diameters.
c. Staminate flowering twig, seven-eighths natural size.
d. Staminate flower, enlarged five diameters.
e. Branch with fruit and nearly mature leaves, seven-eighths natural size.



SALIX AMPLIFOLIA

PLATE XXXVI.

Salix barclayi Anders.

- FIG. *a.* Staminate flowering twig, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering twig, natural size.
d. Pistillate flower, viewed from above, enlarged six diameters
e. Same, lateral view.
f. Fruiting branch, natural size.
g. Capsule, two views, enlarged two diameters.
h. Outlines of leaf margins, enlarged three diameters.



SALIX BARCLAYI

PLATE XXXVII.

Salix commutata Bebb

- FIG. *a.* Staminate flowering twig, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering branch, natural size.
d. Pistillate flower, enlarged six diameters.
e. Fruiting branch, natural size.
f. Capsule, two views, enlarged two diameters.
g. Outline of typical medium-sized leaf, natural size.
h. Outline of leaf margin, enlarged three diameters.



PLATE XXXVIII.

Salix pulchra Cham.

- FIG. *a.* Staminate flowering twig, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering twig, natural size.
d. Pistillate flower, viewed from above, enlarged six diameters.
e. Same, lateral view.
f. Another pistillate flower, viewed from above, same enlargement.
g. Twig with mature fruit, natural size.
h. Portion of twig and fruiting catkin, showing a peduncle, natural size
i. Capsule, two views, enlarged two diameters.
j. Leafy branch, natural size.
k. Typical leaf, showing stipules, natural size.



PLATE XXXIX.

Salix glauca L.

- FIG. *a.* Staminate flowering twig, natural size.
b. Staminate flower, enlarged six diameters.
c. Another staminate flower, same enlargement.
d. Pistillate flowering twig, natural size.
e. Pistillate flower, enlarged six diameters.
f. Another pistillate flower, same enlargement.
g. Branch with leaves and mature fruit, natural size.
h. Capsule, two views, enlarged two diameters.



SALIX GLAUCA

PLATE XL.

Salix arctica Pall.

- FIG. *a.* Staminate flowering branch, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering twig, natural size.
d. Pistillate flower, enlarged six diameters.
e. Branch with leaves and mature fruit, natural size.
f. Capsule, two views, enlarged two diameters.



PLATE XLI.

FIGURE 1.

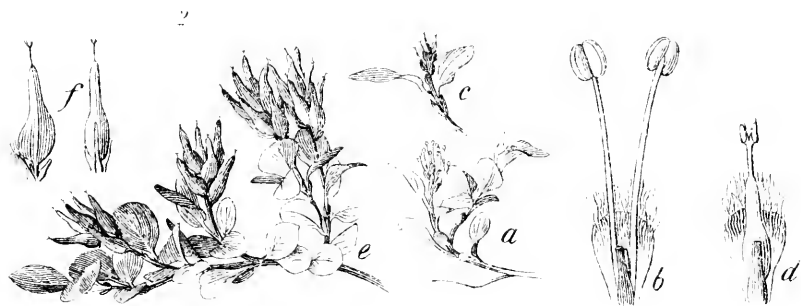
Salix stolonifera Coville.

- a.* Staminate flowering branch, natural size.
- b.* Stáminate flower, enlarged six diameters.
- c.* Pistillate flowering twig, natural size.
- d.* Pistillate flower, enlarged six diameters.
- e.* Fruiting branch, natural size.
- f.* Capsule, two views, enlarged two diameters.
- g.* Portion of underground stem, with stolon, natural size.

FIGURE 2.

Salix leiocarpa (Cham.) Coville.

- a.* Staminate flowering branch, natural size.
- b.* Staminate flower, enlarged six diameters.
- c.* Pistillate flowering twig, natural size.
- d.* Pistillate flower, enlarged six diameters.
- e.* Fruiting branch, natural size.
- f.* Capsule, two views, enlarged two diameters.



SALIX STOLONIFERA
SALIX LEOCARPA

PLATE XLII.

Salix reticulata L.

- FIG. *a.* Staminate flowering branch, natural size.
b. Staminate flower, enlarged six diameters.
c. Pistillate flowering twig, natural size.
d. Pistillate flower, viewed from above, enlarged six diameters.
e. Same, lateral view.
f. Fruiting branch, natural size.
g. Capsule, two views, enlarged two diameters.



SALIX RETICULATA

PROCEEDINGS
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VOL. III, PP. 363-370.

AUGUST 23, 1901.

PAPERS FROM THE HOPKINS STANFORD GALA-
PAGOS EXPEDITION, 1898-1899.

I.

INTRODUCTION.

IN the fall of 1898, Messrs. G. W. Kneass and W. Johnson fitted out, in San Francisco, a sealing schooner, the *Julia E. Whalen*, for a cruise to the Galapagos Islands. Thanks to the generous coöperation and liberality of Mr. Timothy Hopkins, Stanford University was enabled to transform this proposed sealing voyage, in part at least, into a naturalists' voyage. It was arranged that Capt. W. P. Noyes, who commanded the schooner, should take on board two representatives of Stanford University, together with their outfit, should land them on the various islands in the Galapagos group as also upon Cocos and Clipperton Islands, should afford them opportunities to make collections of plants and animals, and should then bring them and their collections back to San Francisco. Dr. C. H. Gilbert, head of the zoölogical department in Stanford University selected as collectors on this voyage, Robert E. Snodgrass and Edmund Heller, advanced students in his department, who had had experience as collectors. Everything was carried out as planned. Snodgrass and Heller with their outfit on board, sailed from San Francisco with Captain Noyes on Oct. 25, 1898, touched at Guadalupe Island, November 5, were at Clipperton Island, November 23d and 24th and reached the Galapagos Islands, December 8, 1898. Here they remained about six

months collecting in the various islands till June 23, 1899, and then sailed to Cocos Island where they remained five days, June 29th to July 3d. Thence they sailed homeward and after touching at Clarion Island, in the Revillagigedo group, on August 2, they arrived in San Francisco on August 15, 1899.

Their collections include mammals, birds, reptiles, fishes, insects, mollusks, arachnida, crustacea, echinoderms and plants in all of which departments they strove to make full collections. Most of the material will be permanently retained in Stanford University. The spiders and insects have been sent to Dr. L. O. Howard, in Washington, for distribution to and study by the government specialists in the various orders. All the collections are to be studied and reported upon by specialists and the results published in these proceedings under the general heading *Papers from the Hopkins Stanford Galapagos Expedition, 1898-1899*.

ENTOMOLOGICAL RESULTS (1):

HEMIPTERA.

BY OTTO HEIDEMANN.

U. S. DEPARTMENT OF AGRICULTURE.

IN the collection of hemipterous insects brought back from the Galapagos Islands by Mr. R. E. Snodgrass, in 1899, I find two species new to science. These are described in this paper. Several others, though previously known, had not been previously reported from or collected in the Galapagos.

Family PENTATOMIDÆ.

1. *Podisus sordidus* Stal.

Podisus sordidus STAL, Freg. Eug. Resa, Ins., p. 221, 1859.

Charles, May 10, 1899. Indefatigable, April 28, 1899. Chatham, May 25, 1899. Albemarle, March 11 and 23, 1899.

Six specimens and five specimens in larval stage; three males and females. Stal's type came from the Galapagos Islands.

2. *Mutica grandis* Dallas.

Canthecona grandis DALLAS, List I, Hemipt., p. 91, 1852.

Charles, June 25, 1899.

One specimen, a female. This species is found in the West Indies, Mexico and Brazil. It is also recorded from Florida.

3. *Nezara viridans* Stal.

Nezara viridans STAL, Freg. Eug. Resa, Ins., p. 128, 1859.

Albemarle, February 1, 1899.

A single specimen, a male. The species also occurs in Peru and Panama. It had previously been recorded from Chatham Island in the Galapagos archipelago by Mr. P. R. Uhler (Scien. Res. Expl. Fish Comm. Steamer Albatross).

4. *Thyanta perditor* Fabricius.

Cimex perditor FABRICIUS, Ent. Syst., IV, p. 102, 1794.

Albemarle, June 9, 1899. Chatham, May 25, 1899.

Two specimens; male and female. It belongs to the group which has the spines on the lateral margin of the thorax shorter.

Family COREIDÆ.

5. *Anasa obscura* Dallas.

Anasa obscura DALLAS, List II, Hemipt., p. 505, 1852.

Chatham, May 25, 1899.

Two specimens, male and female. Originally described from the Galapagos Islands.

6. *Jadera sanguinolenta* Fabricius.

Cimex sanguinolenta FABRICIUS, Syst. Ent., p. 721, 18, 1775.

Wenman, December 18, 1889.

Four specimens, males and females. Two are of the brachypterous form. This species occurs in the West Indies, in Brazil, and is also found in Paraguay.

7. *Stenocephalus insularis* Dallas (?).

Stenocephalus insularis DALLAS, List II, Hemipt., p. 482, 1852.

Indefatigable, April 28, 1899.

A single specimen. It seems to agree with the description by Dallas, but the specimen is too soiled to allow a definite determination.

The type specimen came from the Galapagos Islands.

8. *Harmostes serratus* Fabricius.

Coreus serratus FABRICIUS, Ent. Syst. IV, p. 133, 1794.

Albemarle, February 25, 1899.

Two specimens, male and female. The specimens have the principal characters of *Harmostes serratus* Fabr., but differ somewhat in having a shorter rostrum; they belong to the pale variety.

Family BERYTIDÆ.

9. *Jalysus* (*Metacanthus*) *tenellus* Stal.

Jalysus tenellus STAL, Freg. Eug. Resa, Ins., p. 236, 1859. Enum. Hem., IV, p. 128, 1874.

Chatham, May 27, 1899.

One specimen, which agrees very well with Stal's description, differing only in the length of the fourth joint of antennæ, which is much shorter than the second.

Family LYGÆIDÆ.

10. *Nysius marginalis* Dallas.

Nysius marginalis DALLAS, List II, Hemipt., p. 556, 1852.—STAL, Freg. Eug. Resa, Ins., p. 252, 1859.—BUTLER, Proc. Zool. Soc. London, p. 85, 1877.

Two specimens; male and female. This species has never been reported from any place outside of the Galapagos Islands.

Family CAPSIDÆ.

11. *Miris lineata* Butler.

Miris lineata BUTLER, Proc. Zool. Soc. London, p. 89, 1877.

Albemarle, June 12, 1899.

Two specimens, one is a larva. The adult specimen agrees very well with Mr. A. G. Butler's description of a *Miris* from Charles Island (Galapagos Islands) except that it is somewhat larger.

Family REDUVIIDÆ.

(Subfamily Harpactoridæ.)

12. *Cosmoclopius* (*Harpactor*.) sp.?

Albemarle, June 12, 1899.

One specimen in the larval condition. Probably *Harpactor nigro-annulatus* Stal.

(Subfamily Nabidæ.)

13. *Nabis punctipennis* Blanchard.

Nabis punctipennis BLANCHARD: GAY, Hist. de Chili, Zool., VII, p. 161, 1852.—SIGN, Ann. Soc. Ent. de France, Ser. 4, III, p. 577.

Charles, May 10, 1899. Albemarle, March 23, 1899.

Two specimens; male and female. It very closely resembles the common species *Nabis ferus* Linné.

(Subfamily Emesidæ.)

14. *Ghilianella galapagensis* sp. nov.

A female.—Body slender, color brown, abdomen mottled with darker brown. Head nearly three-fourths the length of prothorax, sparsely granulated, eyes moderate; the usual porrect frontal spine is reduced to a blunt tooth. Antennæ light brown, first and second joints equal; the terminal joints are wanting in the specimen. Front legs ochraceous, comparatively short and stout, the large spine near base of femora tipped with black; tibiæ faintly annulated with brown, front tarsi claw-like, equal in length with the tibiæ; femora of the middle legs about as long as abdomen, but the femora of the hind legs longer; the tibiæ annulated, at base pale ochraceous. Mesothorax and metathorax equal in length; prothorax a little longer and ornamented with two oval-shaped spots, and a longitudinal line in the middle, pale ochraceous, also a streak on the sides near apex; above densely covered with small brown granules, less so below. Mesothorax and metathorax have a flat surface, the sides obsoletely granulated and sharply edged, and a longitudinal, raised line in the middle; a well defined carina on the underside of the body runs from the base of mesosternum down to the apex of sixth segment of abdomen. The abdomen is gradually inflated from the end of second segment to the fifth and then narrowing slightly towards apex; the lateral margins are a little raised, more so on the last segments; the first genital segment is slightly sloping, and the apex rounded off, the second abruptly declivous; dorsal part of abdomen flat, under side much rounded; first and second segments, seen from above, equally long; the third, fourth and fifth gradually become shorter, the sixth segment is shortest; at sides of second segment a little behind its base are two small erect spines, also small tubercles at apex in the middle of nearly all the segments, the one on the fourth segment is more prominent. The under side of abdomen is beset with small, stiff, golden hairs, which are irregularly arranged. Length 13 mm.

Type.—No. 4931, U. S. Nat. Mus.

One specimen, collected on Hood Island, May 8, 1899, and one larva collected on Albemarle Island, March 15, 1899. This insect seems so distinct from the other species of the genus, that I have ventured to describe a new species from but one specimen. It somewhat resembles *G. gibbiventris* Champ. and also *G. filiventris* Spin., but differs from both in length of meso- and metathorax, which are equally long, and in the structure of the abdominal segments. The

species can be easily distinguished by the reduced frontal spine and by the pale ornamental spots on the prothorax.

Family SALDIDÆ.

15. *Salda rubromaculata* sp. nov.

A male.—Body blackish, pubescent, with fuscous and yellow markings. Head stout, black between the eyes, in front yellow; two short, black lines running sideways to the cheeks, which are yellow; tylus testaceous, polished, prominent, and much curved downwards; underside of head yellowish, on the middle of the throat a black mark; the occiput carries behind the ocelli two orange-yellow, round dots, which are quite conspicuous. Antennæ yellowish, the ultimate joints more fuscous. Rostrum yellow, at tip blackish, reaching the intermediate coxæ. Pronotum twice as wide as long, slightly narrowing anteriorly to nearly the same width as the head: the callosities, forming the anterior lobe, convex, not reaching the sides, rounded by an impressed, transverse line, which is deeper in the middle; the anterior margin straight, narrow, yellow, behind it a round, sunken line; posterior margin very concave; the lateral margins straight, narrow, flattened, somewhat reflexed, anteriorly rounded; the humeral angles rectangular, with an oblong tubercle near the sides; color of the thorax yellow, except the anterior lobe, which is black, a little shining, but shows on front of the sides a small forked yellow streak. Scutellum large, twice the length of the thorax, hollowed out a little, before the middle, margins and apex yellow. Hemelytra flat, sericeous; clavus yellow with a black line in the middle, and a brown dot near the apical part; corium yellow, the inner side towards apex dark fuscous, maculated with reddish-brown; near costal margin a darker streak with a black spot behind the middle, also one at apex of corium and base of membrane; the discal and apical areoles more pale yellow; sutures and nervures blackish; costal margins narrow and entirely yellow. Membrane pale, with five long areoles; veins are brownish. Legs yellow, the femora above a little infuscated, coxæ fuscous. Sternum black, with broad yellowish-white margins. Abdomen dark brown, densely covered with fine hairs; the segments edged with yellow, the genital segment yellowish at apex.

Length, 3.5 mm.; width, 1.5 mm. Type—No. 4930, U. S. Nat. Mus.

One specimen from Albemarle Island, January 23, 1899. This new species belongs to the group, having membrane consisting of five cells. Judging from the descriptions of *S. ventralis* Stal, and *S. argentina*

Berg, it seems to approach these. In size and color, it more nearly resembles the latter, but differs in the arrangement of the spots on the corium and membrane, and in having costal margins entirely yellow.

Family GERRIDÆ.

16. *Halobates Wuellersdorffi*, Frauenfeld.

Halobates Wuellersdorffi FRAUENFELD, Verh. Zool. Ges., v, 17, p. 418.—B. WHITE, Challenger Exp. Zool., v, VII, p. 40.

Seven specimens, three males and four females, were taken between Clarion and Clipperton Islands, November 2, 1898. Other specimens were previously found near James Island, Galapagos Islands (Proc. U. S. Nat. Museum, v, XIII, p. 194), and in the North Pacific near the California coast. In this lot of *Halobates* was one female, which carried a few eggs on her under side, attached to the last segments of the abdomen. This bug must have been captured in the very act of egg-laying, as one egg is protruding from the ovipositor. The following notes on the subject of egg-laying are from Professor Buchanan White in his report on the Pelagic Hemiptera (Challenger Exp. Zool., v, VII, p. 71). He says: "No observations have been made as to when and where the eggs are deposited. The statement, that the female carries them about, attached to the abdomen, after they have been extruded, Professor Moseley informs me is a mistake."

Dr. E. Witlaczil in his treatise on *Halobates* (Wiener Ent. Zeit., Vol. v, p. 233, 1856) mentions, that, during the voyage of the *Pisani* a feather of a bird was fished out from the ocean, off the southwest coast of the Galapagos Islands, entirely covered with eggs of a reddish color. Doctor Witlaczil prepared them for microscopical examination, and could distinctly observe the embryos of a *Halobates*.

17. *Halobates* sp.?

Albemarle, January 2, 1899.

Five specimens, four females and one male. Doubtless a new species. The material, however, is in such condition that it can not be satisfactorily described. The middle tarsi of all the specimens are more or less damaged. This oceanic bug closely resembles *Halobates sericeus* Eschscholtz in shape of body and in color; also to *Halobates hayanus* B. White in form of antennæ and front tarsi. But it resembles more closely *Halobates germanus* B. White in the structure and color of the abdominal and genital segments, and differs only in the terminal joints of antennæ, of which the third and fourth are nearly equal, and the second a little longer than the fourth, whilst in

that species the fourth joint is longer, and the third comparatively smaller. In the front tarsi the second joint is shorter, being half the length of the first joint. The insect also shows some affinities to *Halobates regalis* Carpenter, and *Halobates incanus* Witlaczil.

SUBORDER HOMOPTERA.

Family FULGORIDÆ.

18. **Mycterodus productus** Stal.

Mycterodus productus STAL, Freg. Eug. Resa, Ins., p. 278, 1859.

Albemarle, January 23, 1899.

Nine specimens, varying in color.

19. **Jassus (Deltocephalus)** sp.?

Albemarle, January 23, 1899.

One single specimen, not quite mature.

20. **Jassus** sp.?

Albemarle, January 1, 1899.

One specimen; mutilated beyond recognition.

21. **Cicada** sp.?

A single specimen, in the first or second pupal stage, found on Cocos Island, February 2, 1899. It burrows in the ground and may be found in that stage of development about two feet beneath the surface

PROCEEDINGS
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NOVEMBER 7, 1901.

PAPERS FROM THE HOPKINS STANFORD GALA-
PAGOS EXPEDITION, 1898-1899.

II.

ENTOMOLOGICAL RESULTS (2):

DIPTERA.

By D. W. COQUILLET.

CUSTODIAN OF DIPTERA, U. S. NATIONAL MUSEUM.

THE earliest recorded capture of Diptera on the Galapagos Islands occurred during the cruise of the British Frigates *Adventure* and *Beagle* in the years 1826 to 1836, made famous by Darwin's celebrated Narrative, published in 1839. The few Diptera then collected were described by Walker in the well-known British Museum Lists.

During the years 1851 to 1853 the Swedish frigate *Eugenies* also visited these islands, and collected Diptera; these were described by C. G. Thomson in 1868.

The British steamship *Petrel* visited them in 1875, and obtained two species of Diptera; these were reported upon by F. Smith in the Proceedings of the Zoological Society of London for 1877, page 84.

Finally, the U. S. steamer *Albatross*, during her cruise in 1887 and 1888 also visited these islands and collected several specimens of an undetermined species of *Culex*, reported upon by Dr. S. W. Williston in the report published by Dr. L. O. Howard in the Proceedings of the U. S. National Museum, Vol. XII, 1889.

During the autumn of 1899 Dr. Howard received, in addition to insects belonging to nearly all other orders, a series of Diptera collected in the Galapagos Islands by Mr. Snodgrass, of the Hopkins Stanford Galapagos Expedition in the early part of that year. This collection, submitted to the National Museum through Professor Vernon L. Kellogg, contains 413 specimens, representing 35 species, distributed in 26 genera and 17 families. One genus and nine species are believed to be new to science; eleven species were originally described from specimens collected on these islands, while the remaining fifteen species have hitherto been reported from South or Central America, the West Indies, or the warmer portion of North America.

Family CHIRONOMIDÆ.

CERATOPOGON GALAPAGENSIS sp. nov.

Head black, antennæ yellow, the first joint and apical half dark brown, its hairs dark brown, many towards the apex tipped with yellowish white, proboscis and palpi yellowish brown, the latter slender and almost linear; body dark brown, its hairs yellow, the humeri and a vitta on upper part of pleura yellow, mesonotum opaque; legs, including the coxæ, wholly light yellow, femora not swollen, destitute of spinous bristles, first joint of hind tarsi slightly over one-half as long as the second, last joint subequal to the fourth, not spinose below, the claws small and of an equal size; wings hyaline, thickly covered with hairs, third vein ending in the costa near middle of the latter, united to the first vein except at each end, second posterior cell rather long petiolate; halteres yellowish white; length 1.25 mm. Tagus Cove, Albemarle. Three males, collected January 22, 1899.

Type.—Cat. No. 4714, U. S. National Museum.

Family CULICIDÆ.

CULEX TÆNIORHYNCHUS Wied.

Culex tæniorhynchus WIEDEMANN, Diptera Exot., p. 43, 1821.

Albemarle, January 28 and February 1 and 4. Eight specimens. Occurs over the warmer portion of this continent. The female has dentate front tarsal claws, and Arribalzaga's *Tæniorhynchus tæniorhynchus* Wied., with simple claws, must therefore belong to some other species.

Family TIPULIDÆ.

GERANOMYIA STIGMATICA Philippi.

Plettusa stigmatica PHILIPPI, Verhand. Kais. Kön. Zool.-bot. Gesell. Wien, xv, p. 598, 1865.

Albamarle, June 9. One specimen. Described from Chile.

Family STRATIOMYIDÆ.

PELAGOMYIA ALBITALUS Williston.

Pelagomyia albitalus WILLISTON, Trans. Ent. Soc. London, p. 299, Sept., 1896.

Albamarle, January 1. One specimen. Type locality, St. Vincent, W. Ind.

NEMOTELUS ALBIVENTRIS Thomson.

Nemotelus albiventris THOMSON, Fregatt. Eugen. Resa, p. 462, 1868.

Albamarle, January 1. A single specimen. The locality, "Manilla," given by Thomson, is probably erroneous. The frigate *Eugenies* also made collections at the Galapagos Islands.

NEMOTELUS ACUTIROSTRIS Loew.

Nemotelus acutirostris LOEW, Berl. Ent. Zeitsch., vii, p. 8, 1863.

Albamarle, January 1. A single specimen. This species was originally described from Cuba.

Family TABANIDÆ.

TABANUS VITTIGER Thomson.

Tabanus vittiger THOMSON, Fregatt. Eugen. Resa, p. 451, 1868.

James, April 21 and 22; Indefatigable, April 28, and Albamarle, January 23. Six specimens. Originally described from the Galapagos Islands.

Family BOMBYLIDÆ.

ANTHRAX NUDIUSCULA? Thomson.

Anthrax lateralis THOMSON, Fregatt. Eugen. Resa, p. 482, 1868. *Nec* SAY, 1823.

Anthrax nudiuscula? THOMSON, l. c.

Albamarle, January 1, 17, 18 and 23, and March 21; Charles, May 10. Ten specimens. *A. lateralis* was described from the Galapagos Islands; *A. nudiuscula* from Panama.

ANTHRAX BRACHIALIS Thomson.

Anthrax brachialis THOMSON, loc. cit., p. 484.

Albemarle, January 1. A single specimen. Described from the Galapagos Islands.

Family ASILIDÆ.

OMMATIUS MARGINELLUS Fabr.

Asilus marginellus FABRICIUS, Spec. Ins., II, p. 464, 1781.

James, April 21. A single specimen. Originally described from the West Indies, it has also been reported from Brazil.

Family DOLICHOPODIDÆ.

ANCHINEURA TIBIALIS Thomson.

Anchineura tibialis THOMSON, loc. cit., p. 507.

Albemarle, January 18 and 23; Narboro. January 13. Five specimens. Originally described from the Galapagos Islands.

PARACLIUS PUSILLUS? Macq.

Dolichopus pusillus? MACQUART, Dipt. Exot., Sup. I, p. 121, 1844.

Albemarle, January 23; Narboro. January 13. Fourteen specimens. Macquart's specimens of *pusillus* came from Brazil.

Family SYRPHIDÆ.

BACCHA CLAVATA Fabr.

Syrphus clavatus FABRICIUS, Ent. Syst., IV, p. 298, 1794.

Baccha facialis THOMSON, Fregatt. Eug. Resa, p. 504, 1868.

James, April 22; Charles, May 10. Two specimens. Thomson described it from the Galapagos Islands. The synonymy is by Dr. Williston.

SPHÆROPHORIA SPLENDENS Thomson.

Syrphus splendens THOMSON, Fregatt. Eug. Resa, p. 501, 1868.

James, April 21; Charles, May 10. Three specimens. Thomson's specimens also came from the Galapagos Islands.

MESOGRAMMA DUPLICATA Wied.

Syrphus duplicatus WIEDEMANN, Ausser. Zweif. Ins., II, p. 142, 1830.

James, April 22. Two specimens. This species has been reported from nearly all parts of South America.

Family SARCOPHAGIDÆ.

SARCOPHAGA OBTUSIFRONS Thomson.

Sarcophaga obtusifrons THOMSON, Fregatt. Eugen. Resa, p. 536, 1868.

Albemarle, January 1, and Charles, May 10. 103 specimens. This

and the two following species were originally described from the Galapagos Islands.

SARCOPHAGA INOA Walker.

Sarcophaga inoa WALKER, List Dipt. Ins. Brit. Mus., iv, p. 832, 1849.

Albemarle, January 1 and 16; Narboro, January 13 and 26; Hood, May 15, and Calpepper, December 10. 48 specimens.

SARCOPHAGA VIOLENTA Walker.

Sarcophaga violenta WALKER, loc. cit., p. 826.

Albemarle, January 18. Seven specimens.

CHRYSOMYIA QUADRISIGNATA Thomson.

Lucilia quadrisignata THOMSON, Fregatt. Eug. Resa, p. 544, 1868.

Albemarle, January 1, and Charles, May 10. Eight specimens. Originally described from the Galapagos Islands.

Family MUSCIDÆ.

SYNTHESIOMYIA BRASILIANA Br. and Bergen.

Synthesiomyia brasiliiana BRAUER and BERGENSTAMM, Denks. Math. Nat. Kais. Akad. Wiss., LX, p. 96, 1893.

Albemarle, January 1 and 16. Two specimens. Originally described from Brazil; the U. S. National Museum contains specimens collected in Georgia and Florida.

Family ANTHOMYIDÆ.

LEUCOMELINA PICA Macquart.

Leucomelina pica MACQUART, Dipt. Exot., Sup. iv, p. 235, 1849.

Cocos Island, in July. Twenty-five specimens. Described from Brazil, and also reported from Mexico.

OPHYRA SETIA Walker.

Anthomyia setia WALKER, List Dipt. Ins. Brit. Mus., iv, p. 956, 1849.

Albemarle, January 1 and 16; Narboro, January 13. Twelve specimens. Originally described from the Galapagos Islands.

HOMALOMYIA CANICULARIS Linné.

Musca canicularis LINNÉ, Fauna Suec., p. 1841, 1761.

Albemarle, January 1. Three specimens. A nearly cosmopolitan species.

Family ORTALIDÆ.

EUXESTA NOTATA Wied.

Ortalis notata WIEDEMANN, Ausser. Zweif. Ins., II, p. 462, 1830.

Charles, May 10. A single specimen. A common species over the greater part of the United States.

EUXESTA NITIDIVENTRIS Loew.

Euxesta nitidiventris LOEW, Mon. Dipt. N. Amer., III, p. 157, 1873.

Albemarle, January 1, and Charles, May 10. Thirteen specimens. Originally described from Texas; it also occurs in Georgia and Florida.

PAREUXESTA gen. nov.

Near *Euxesta*, but the first vein covered with bristles on its apical third. Front not punctured, sparsely covered with bristly hairs except around the ocelli, slightly tapering to the lower end, where it is almost as wide as either eye, antennæ two-thirds as long as the face, the third joint ellipsoidal, one-half longer than wide, twice as long as the second, which is scarcely longer than wide, arista bare, face in profile concave, not carinate nor foveolate, projecting slightly further forward at oral margin than at base of antennæ, clypeus prominent, proboscis short and swollen, palpi well developed, of nearly an equal width, cheeks less than one-fourth as wide as the eye-height, occiput slightly concave on its upper part, thorax bearing one pair of acrostichal bristles, two dorsocentral, three supra-alar, one humeral, two post-humeral, one mesopleural and one sternopleural, scutellum bearing four bristles, abdomen ovate, legs short and robust, calypteres small, wings slightly tapering to their apices, fourth vein distinctly converging toward the third, lower outer angle of anal cell drawn out in a long lobe, small crossvein perpendicular, the hind one nearly so, stigma short, distance between apices of auxiliary and first veins much less than length of hind crossvein.

Type, the following species:

PAREUXESTA LATIFASCIATA sp. nov.

Head reddish brown, opaque, the occiput (extending as ocellar and orbital triangles upon the front), also usually the face, clypeus and lower edge of cheeks, bluish; narrow frontal orbits, face, upper and lower border of cheeks and occiput, whitish pruinose; antennæ and palpi yellowish brown; proboscis and apices of aristæ black; body bluish, subopaque, the abdomen somewhat polished; an opaque blackish streak in front of each wing, extending along the posterior side of

the mesonotal suture; last two abdominal segments of female yellow, her ovipositor broad, flattened, scarcely tapering at the apex, bluish, the base yellow; legs blackish brown, apices of femora yellow; wings whitish hyaline, marked with four rather broad black crossbands, the first just beyond humeral crossvein, second filling stigma and extending in a curve to slightly below fifth vein beyond apex of anal cell; small crossvein situated beyond this band, third band extends from beyond apex of first vein to lower end of hind crossvein, the fourth borders apex of wing from nearly midway between apices of first and second veins to slightly below apex of the fourth, and is sometimes narrowly connected with the third band along the costa; at the third vein the apical brown band is from two-thirds as wide to as wide as the preceding hyaline interval; length, 3 to 4 mm. Fifty-nine males and eleven females. Tower, June 23.

Type.—Cat. No. 5557, U. S. National Museum.

PAREUXESTA OBSCURA sp. nov.

Same as *latifasciata* except that the entire abdomen and ovipositor of the female are bluish, and the black bands of the wings, especially the last two, are narrower, the apical band at the third vein less than one-fourth as wide as the preceding hyaline interval; length 3 to 3.5 mm. Seventeen males and four females. Albemarle, January 1.

Type.—Cat. No. 5558, U. S. National Museum.

PAREUXESTA INTERMEDIA sp. nov.

Equal to *latifasciata* except that the penultimate segment of abdomen of the female is bluish, like the preceding segments, and the black bands of the wings are noticeably narrower, the apical band at the third vein being from one-half to three-fifths as wide as the preceding hyaline interval; length, 3 to 4 mm. Two males and a female. Albemarle, January 1.

Type.—Cat. No. 5559, U. S. National Museum.

PAREUXESTA HYALINATA sp. nov.

Like *latifasciata* except that the penultimate abdominal segment of the female is bluish, and the wings are hyaline, unmarked; length, 3.5 mm. Two females. Albemarle, January 1.

Type.—Cat. No. 5560, U. S. National Museum.

Family EPHYDRIDÆ.

EPHYDRA GILVIPES sp. nov.

Green, tinged in places with blue; halteres, femora and tibiæ yellow; tarsi brown; antennæ and proboscis black; middle of front

polished, the narrow sides, occiput, cheeks and face, except middle of the upper part of the latter, opaque, gray pruinose; two pairs of fronto-orbital bristles, no medio-frontal macrochaeta below the ocelli; antennal arista bearing a short pubescence on the upper side; body polished, thorax bearing five pairs of dorsocentral bristles, scutellum bearing four bristles; wings hyaline, spines of costa only slightly longer than the diameter of the costal vein; front tarsi of male not swollen; length, 4 to 5 mm. Albemarle, February 13. One male and five females.

Type.—Cat. No. 4429, U. S. National Museum.

CANACE SNODGRASSII sp. nov.

Black; the palpi, halteres and tarsi yellow; front polished; four pairs of fronto-orbital bristles, and a short distance toward middle of front from these a row of three or four bristles; occiput, cheeks, face and clypeus opaque, light gray pruinose; two stout bristles in the vibrissal region and one slightly above and behind the center of each cheek; antennal arista almost bare; eyes slightly longer than high; cheeks posteriorly as wide as the eye-height; body subopaque, thinly grayish pruinose, the pleura densely light gray pruinose; five pairs of dorsocentral bristles; scutellum bearing four marginal bristles and a smaller discal pair; wings grayish hyaline; length, 3 mm. Albemarle, January 23; and Narboro, January 13 and 26. Many specimens.

Type.—Cat. No. 4430, U. S. National Museum.

Family OSCINIDÆ.

HIPPELATES PUSIO Loew.

Hippelates pusio LOEW, Berl. Ent. Zeitsch., p. 279, 1872.

Tagus Cove, Albemarle, March 23. Three specimens. Also occurs in this country, ranging from Massachusetts southward to Florida and Texas.

Family AGROMYZIDÆ.

RHICNESSA COSTALIS sp. nov.

Head black, opaque, gray pruinose; lower half of front yellowish brown; face and cheeks yellow; antennæ brown; pubescence of arista very short; proboscis brown; palpi yellow; body black, opaque, gray pruinose, mesonotum marked with two indistinct brown pruinose vittæ; four pairs of dorsocentral bristles; legs yellow, the coxæ and front legs dark brown; wings grayish-hyaline, the costal margin between apices of first and second veins brown, sometimes encroaching

considerably on the submarginal cell; halteres whitish; length, 1.5 mm. Tagus Cove, Albemarle, March 23. Two specimens.

Type.—Cat. No. 4715, U. S. National Museum.

Family HIPPOBOSCIDÆ.

PSEUDOLFERSIA DIOMEDEÆ sp. nov.

Head brown; a transversely-oval, elevated, polished, frontal spot reaching slightly below the middle of the front; a transverse parallelogrammatic one occupying the lowest median fourth of the front; orbits elevated and polished; remainder of the front depressed, opaque, gray pruinose; shorter hairs of antennæ yellow, the stronger ones dark brown, changing into yellow at their apices; thorax polished brown, the angles yellow, the sides, transverse suture, a spot towards the middle of the thorax from each humerus and a second spot a short distance behind each of these, also two spots in front of the scutellum, opaque, gray pruinose; middle of sternum yellow; scutellum polished dark brown, destitute of bristles, posteriorly truncate and ciliate with very short hairs; abdomen dark brown, opaque, gray pruinose; wings hyaline, veins brown, the first vein, except its base, usually yellow, last section of the fifth vein and the whole of the sixth except its base, whitish; apex of first vein noticeably before the small crossvein, apex of second vein about twice as far from the apex of the first vein as from tip of the third; legs brown, the lower side of the femora and the tibiæ except their outer and inner edges, yellow; length 7 mm. Albemarle, March 1. Four specimens, taken on an albatross (*Diomedea irrorata* Salvin).

Type.—Cat. No. 4431, U. S. National Museum.

PSEUDOLFERSIA FOSSULATA Macquart.

Olfersia fossulata MACQUART, Dipt. Exot., II, p. 434, 1842.

Wenman, December 13. A single specimen. Originally described from Brazil.

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PAPERS FROM THE HOPKINS STANFORD GALA-
PAGOS EXPEDITION, 1898-1899.

III.

ENTOMOLOGICAL RESULTS (3):

ODONATA.

[TEXT FIGURES 29-34.]

BY ROLLA P. CURRIE,

AID, DIVISION OF INSECTS, U. S. NATIONAL MUSEUM.

THE dragonflies contained in the following list were collected by Mr. R. E. Snodgrass in the period from February to August, inclusive, of the year 1899. They comprise seven species including sixteen specimens.

The only references to Galapagos Odonata heretofore published are contained in the following papers:

1. Account of the Zoological Collection made during the visit of H. M. S. *Petrel* to the Galapagos Islands. Communicated by Dr. Albert Günther * * * Neuroptera. By R. McLachlan. Proc. Zool. Soc. London, pp. 84-86, 1877. Two species were recorded, *Pantala hymenæa* and *Tramea* species (probably the species afterwards described as *T. darwini* by Kirby).

2. Scientific results of explorations by the U. S. Fish Commission steamer *Albatross*. V. Annotated catalogue of the insects collected in 1887-88. By L. O. Howard. Proc. U. S. National Museum, XII, No. 771, p. 194, 1889. Four speci-

mens of *Æschna* and one *Tramea* mentioned without specific determination.

3. A revision of the subfamily Libellulinae, with descriptions of new genera and species. By W. F. Kirby. * * * Trans. Zool. Soc. London, XII, p. 315, Pl. LI, fig. 1, August, 1889. *Tramea darwini*, new species, described.

It will therefore be seen that the collection here reported upon is the most complete thus far made upon these islands.

Family AGRIONIDÆ.

1. ANOMALAGRION HASTATUM (Say).

Agrion hastata SAY, Journ. Ac. Phila., VIII, p. 38, 1839.

Agrion hastatum HAGEN, Syn. Neur. N. Am., p. 77, 1861.

Anomalagrion hastatum SELYS, Bull. Acad. Belg. (2), XLI, p. 255, 1876.—

KIRBY, Synonymic Cat., p. 140, 1890.—CALVERT, Trans. Am. Ent. Soc., XX, p. 240, 1893.—KELLICOTT, Bull. Ohio State Univ. (4), No. 5, p. 49, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, Blatchley, Indianapolis, p. 280, 1900.

Three males and three black females, Albemarle Island, February 14 (Nos. 47-52, inclusive). At first I regarded the females as belonging to some species of *Ischnura*, but their resemblance to the males, in size and general appearance, led me to compare them with the supposed black females of *A. hastatum* contained in the National Museum collection and also with the females of *Ischnura verticalis* Say. This comparison resulted in revealing a difference in the form of the median lobe of the prothoracic hind margin. In *Anomalagrion* this is obtusely rounded, flattened, and slightly emarginate or grooved in the middle. In the specimens of *Ischnura* the lobe is rounded, but more acutely, *not* flattened nor emarginate medially. The emargination of *A. hastatum* seems to be slightly more pronounced in the Galapagos specimens than in those from Washington, D. C., and other localities in the eastern United States.

Distribution.—North America, Cuba, Venezuela, Galapagos Islands.

Family ÆSCHNIDÆ.

2. ÆSCHNA GALAPAGOENSIS sp. nov.

Male.—Face pale blue or green, the fronto-nasal suture black; frons with a line separating it from the eyes, and a T-spot above, black, stem of T narrowing anteriorly: clypeus twice as broad as long; labrum pale green or blue, a transverse black line on its basal

margin, its free edge brown; maxillæ and labium pale blue or green, more or less tinged with brown, especially at their apices; vertex black at base, the elevated portion emarginate anteriorly, pale yellow or blue; occiput pale yellow, its hind margin straight; rear of eyes black.

Thorax pale brownish, each side with two oblique pale blue stripes, beneath with some black spots; mid-dorsal thoracic carina, humeral and second lateral sutures blackish. Legs black, coxæ and bases of femora brown, anterior femora pale brown or luteous beneath.

Abdomen with segments 1 and 2 inflated, 3 constricted before the middle, remaining segments subequal in width; brown, marked with blue or green as follows: all of 1, except a posteriorly-emarginate basal spot on the dorsum; sides of 2, except some dark spots inferiorly; apical portion of dorsum of 2, except transverse median carina and posteriorly a line on each side parallel to it (the basal brownish area on this segment reaches this carina at its middle); sides of 3 anteriorly; a transverse band on the apex of 3-9, interrupted at the longitudinal median carina; a transverse spot on the middle of 3-8, also interrupted at the carina, large on 8, small on the other segments; sides of 3-8 each with three consecutive spots, sometimes indistinct, sometimes large and more or less coalescent, the posterior spot uniting with the apical dorsal band; a dorsal spot covering apical two-thirds of 10, and some apical spots. Sternum of 1 with an acute, prominent tuber-

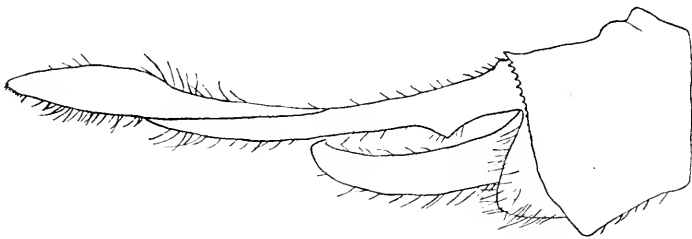


FIG. 29. *Aeschna galapagoensis*. Right side of 10th segment and appendages.

cle which is beset with short spines and long hairs. Auricles of 2 bidentate. A mid-dorsal, basal, keel-like tooth on 10 as in *californica* and *cornigera*, but with three parallel, smaller ones each side; apical margin of 10 somewhat denticulated, this segment a little wider than long.

Superior appendages as long as, or a little longer than, 9 + 10, slightly recurved, their bases slender; basal fourth narrow, then

widened on the inner side; apical two-thirds, before the bluntly-pointed apex, with outer and inner sides nearly parallel; outer side slightly convex, with a few small, short spines or denticles; inferior side grooved, with a rather prominent tooth near the base; above, a prominent median longitudinal carina on the widened portion, this carina sharp and strongly elevated apically. Inferior appendage less than one-half as long as the superiors, subtriangular, strongly grooved above; apex narrow, truncate, a little upcurved.

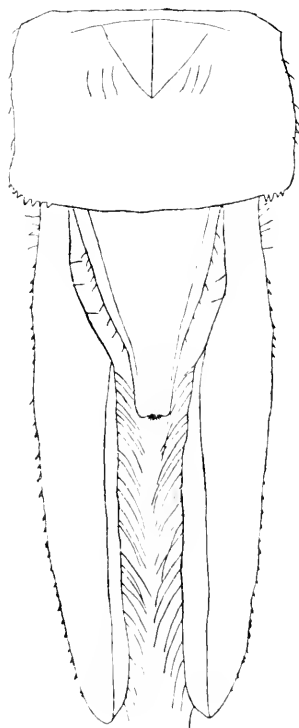


FIG. 30. *Aeschna galapagoensis*. Dorsal view of 10th segment and appendages.

Wings hyaline, with a uniform slight fuscous tinge, the posterior ones yellowish at extreme base. Antenodal portion of costa and some transverse veins in basal part of wing pale, other veins black. Pterostigma almost black. Membranule cinereous, its basal third or fourth whitish. Supra-triangular space with one transverse vein in hind wings, none in front wings; triangle with four cells, two on proximal side (one on this side in right hind wing of this specimen); internal triangle 1-celled (2-celled in left forewing); on or more columns of four cells between subnodal sector and the supplementary sector below it; fore wings with 13-14 antecubitals in first series (14 in right wing, 13 in left), 10 postcubitals; hind wings with 8-10 antecubitals (8 in right wing, 10 in left), 11 postcubitals; 1st and 5th antecubitals thicker than the others (1st and 7th in left hind wing); anal triangle 3-celled.

Female.—Differs from the male as follows: brown area on dorsum of 2 covering all but two apical spots and a transverse stripe, interrupted in the middle just in front of the carina; dorsal median transverse spot large on both 7 and 8; 10 almost wholly pale, without basal teeth on dorsum but with more numerous denticles on its apical margin above and with many beneath. Appendages slender, lanceolate, as long as 9 + 10. Genital valves reaching a little beyond apex

of 9; valvular processes rather short. The first segment of the abdomen has a sternal tubercle similar to that of the male. Supra-triangular space without cross-veins, triangle 3-celled, internal triangle 1-celled; in front wings, 14-15 antecubitals (14 in left wing, 15 in right), 1st and 5th thickest, 10 postcubitals; in hind wings, 8-9 antecubitals (9 in left wing, 8 in right), the 1st and 5th thickest (1st and 6th in left wing), 11-13 postcubitals (13 in left wing, 11 in right).

Length with appendages, ♂ 60 mm., ♀ 58; abdomen, ♂ 45, ♀ 44; front wing, ♂ 41, ♀ 42.5; hind wing, ♂ 40, ♀ 41; pterostigma of front wings 3.8, of hind wings 3.4; superior appendages, ♂ 4.7, ♀ 4.

Type.—No. 5419, U. S. National Museum. One male and one female, collected on Chatham Island, May 26 (Nos. 45 and 44). The specimens were imperfectly dried and the colors, therefore, are obscured so as to prevent their accurate description.

This species is nearly related to *Eschna cornigera* Brauer and *A. californica* Calvert.¹

3. ANAX sp.

One female, Chatham Island, May 26 (No. 40). This may possibly prove to be *A. amazili* of Burmeister. It agrees well with the description of this species in Hagen's Synopsis of the Neuroptera of North America, except that in this specimen there is no triangular blue spot on the superior surface of frons on each side of the triangular black median spot. The appendages are 5 mm. in length, elliptic-ovate, flat, with a low median carina above.

Family LIBELLULIDÆ.

4. PANTALA FLAVESCENS (Fabricius).

Libellula flavescens FABRICIUS, Ent. Syst. Suppl., p. 285, 1798.

Pantala flavescens HAGEN, Syn. Neur. N. Am., p. 142, 1861.—KIRBY Synonymic Cat., p. 1, 1890.—CALVERT, Trans. Am. Ent. Soc., xx, p. 254, 1893.—KELICOTT, Bull. Ohio State Uni. (4), No. 5, p. 93, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, Blatchley, p. 315, 1900.

Two females, Charles Island, May 10 and 20 (Nos. 42 and 43).

Distribution.—This species is nearly cosmopolitan, being found in the tropical portions of both hemispheres, and in the United States as far north, occasionally, as New Hampshire and Wisconsin.

5. PANTALA HYMENÆA (Say).

Libellula hymenæa SAY, Journ. Ac. Phila., viii, p. 18, 1839.

Pantala hymenæa HAGEN, Syn. Neur. N. Am., p. 142, 1861.—KIRBY, Syn-

¹ Proc. Cal. Acad. Sci. (2), iv, pp. 505-508, Pl. xv, figs. 19, 20, 23, 24, 31 and 32, Feb. 19, 1895.

onymic Cat., p. 2, 1890.—CALVERT, Trans. Am. Ent. Soc., XX, p. 254, 1893.—KELLICOTT, Bull. Ohio State Univ. (4), No. 5, p. 93, March, 1899.—WILLIAMSON, 24th Ann. Rep. Dept. Geol. and Natural Resources, Ind., 1899, Blatchley, p. 315, 1900.

One female, Charles Island, August 2 (No. 39).

Distribution.—United States, Mexico, Cuba, Galapagos Islands.

6. TRAMEA DARWINI Kirby.

Tramea darwini KIRBY, Trans. Zool. Soc. London, XII, p. 315, Pl. LI, fig. 1, August, 1889.—KIRBY, Synonymic Cat., p. 3, 1890.

Two males (Nos. 37 and 38) and one female (No. 46); the former were collected on Chatham Island, May 23 and 27; the latter on Albemarle Island, March 23.

Only the female of this species was described by Kirby, and the single female specimen in this collection agrees well with that description. The males were thought by me to be a different species until compared with a series of seven males and four females in the U. S. National Museum from Hood, Chatham, Charles and South Albemarle Islands, collected by the U. S. Fish Commission. The females of this series show a remarkable variation in the length of the dark-brown basal spot of posterior wings. In some of them it is hardly longer than wide, in others it reaches one-third of the way, one-half of the way, or even farther, towards the hind margin of the wing. Unfortunately the wings are badly torn and the hind margin, in some specimens, is entirely absent so that it is impossible to know whether or not the spot *does* reach this margin in any of them. In the males it reaches the hind margin or to the torn hind edge of the wing. In both sexes the superior surface of the frons and the anterior face of the vertex are more or less extensively, sometimes entirely, metallic purplish, or violet; the labrum has the black portion quite variable in extent, sometimes almost completely covering it, sometimes a mere margin. As the two males of the Snodgrass collection are in fairly good condition, it may be well to describe them here.

TRAMEA DARWINI Kirby.

Male.—Similar to the female. Superior appendages about as long as segments 9 + 10 of abdomen, black, rufous at base; inferior appendage a little more than one-half as long as the superiors, reaching a little beyond the denticulated portion. Hamule not exceeding the genital lobe. Wings very slightly fumose apically; the posterior ones with the basal spot extending outward as far as the median cross-vein and backward to the hind margin, the anal margin hyaline, tinged with rufous.

7. CANNACRIA FUMIPENNIS sp. nov.

Male.—Vertex prominent, truncate, brownish, the suture between it and frons black. Frons, nasus and rhinarium brownish. Labrum brownish, bordered anteriorly with black. Labium black; its palpi brownish, their internal margins bordered with black. Mandibles black, their bases brownish. Occiput dark brownish. Rear of head black, with some brownish spots near the eyes.

Prothorax dark brown or black, the articulating facets or the head brownish; posterior lobe broad, erect, bilobed, edged with brownish. Thorax reddish-brown, the sterna and lateral sutures with some dark brown or black markings. Feet black, the anterior femora at base beneath, and the coxæ, brownish.

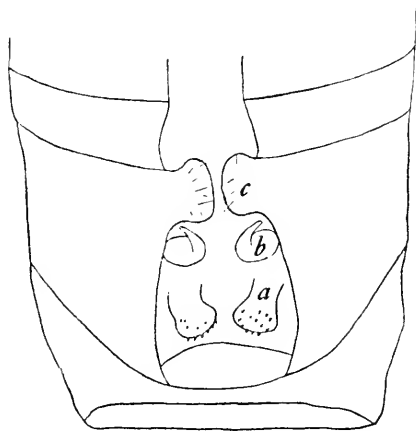


FIG. 32. *Cannacia fumipennis*. Genitalia viewed from below: a, anterior lamina; b, hamule; c, genital lobe.

armed with short spines. Hamule small, simple, curved; apex acute, black, directed outwards. Genital lobe short, projecting downwards as far as the hamule projects, or a little farther, rounded at the apex which is broader than the base."

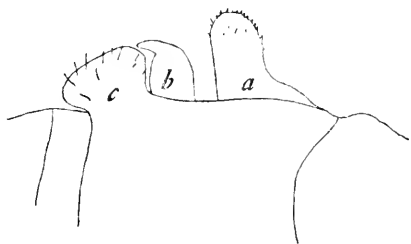


FIG. 31. *Cannacia fumipennis*. Genitalia viewed from the left side: a, anterior lamina; b, hamule; c, genital lobe.

Abdomen yellowish- or reddish-brown; apex of dorsum of 3 black; 4-9 with a median dorsal back band, widening at the apex of each segment and on 8 and 9 covering almost the entire dorsum; 10 mostly reddish-brown, indistinctly darker above. Abdomen beneath with a dark band each side, beginning on 4.

Genitalia similar to *C. grava* Calvert, i. e., the "anterior lamina stout, deeply bifid, its apices projecting further downwards than any other part, and

Superior appendages a little shorter than segments 9 + 10, brownish, with short, sparse hairs. Viewed from above, they are subparallel in their apical half; basal half with inner margins concave, this concavity caused by the basal constriction of the appendage; apex obtuse, rounded, with a small terminal spine on the outer side directed backwards. Viewed from the side, the appendage curves downward strongly from its base, widening to the middle, where it is widest, and where there is a prominent tooth, on the basal side of which are sev-

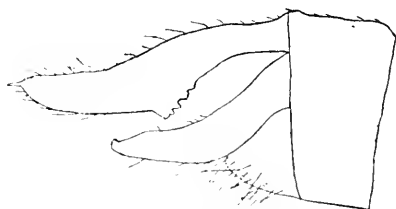


FIG. 33. *Cannacia fumipennis*.
Right side of 10th segment and appendages.



FIG. 34. *Cannacia fumipennis*.
Inferior appendage, viewed from below.

eral denticles; beyond this tooth the superior and inferior margins are straight, subparallel up to the rounded apex and horizontal.

Inferior appendage exceeding the tooth of the superiors by more than one-fourth of the former's length. Viewed from beneath, its lateral margins are slightly convergent from base to apex; the apex broad, rather deeply excised, outline of excision nearly straight in middle portion and *without* a tubercle. Viewed from the side, it is slightly concave, a little widened in the middle; extreme tip black, up-curved, forming a minute blunt hook.

Wings yellowish fusco-hyaline, this color darkest between triangle and front margin (darker on posterior wings than on anterior); the portion of the wings basad of the arculus, from costa to hind margin, is almost clear hyaline with the exception of the extreme base. Venation dark brown or black, lighter basally near front margin. Pterostigma long, rather narrow, dark yellowish, veined with black, surmounting one entire cellule and portions of two others. Membranule small, grayish. 10-11 antecubitals in first series on front wings (10 on left side, 11 on right), 6 on hind wings; 9 postcubitals on front wings, 10-11 on hind wings (10 on left wing, 11 on right, in this specimen), the first three or four postcubitals occurring only in the first series. Three rows of discoidal areolet on anterior wings; on posterior wings, two, increasing. Triangle of front wings crossed by a

single vein, of hind wings uncrossed. Internal triangle of anterior wings 3-celled. On posteriors, no internal triangle. No supra-triangular cross-veins. The single basal postcostal cross-vein is nearer the base than is the first antecubital, in posteriors much nearer.

Length with appendages, 49.7 mm.; abdomen, 34; front wing, 37.6; hind wing, 35.6; pterostigma, 4; superior appendages, 2.6.

Type.—No. 5420, U. S. National Museum, one male collected on Albemarle Island, March 23 (No. 41).

Owing to the condition of the specimen it was impossible to describe the colors accurately. This species agrees remarkably well with the original colored figure and description of *Cannacria batesii* Kirby, but *not* with that author's figure of the male appendages.¹ As pointed out by Calvert,² Kirby's figure represents the superior appendages as without an inferior tooth. This separates *C. batesii*, not only from *C. furcata*, but also from the species here described. According to that figure, too, the apical outline of the inferior appendage of *C. batesii* is unlike that of *C. fumipennis*.

¹Trans. Zool. Soc. London, XII, pp. 300 and 341, Pl. LIII, fig. 1, and Pl. LVII, fig. 9, August, 1889.

²Proc. Cal. Acad. Sci. (2), IV, pp. 547 and 551, Feb. 19, 1895.

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PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXV.

THE ALGÆ.

BY DE ALTON SAUNDERS.

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INTRODUCTION.

COLLECTIONS of algæ were made by the writer and other members of the Harriman Alaska Expedition at Victoria, in British Columbia, and at the following localities in Alaska: Wrangell, Annette Island, Juneau, Glacier Bay, Sitka, Yakutat Bay, Prince William Sound (near Orca and in Virgin Bay), Cook Inlet, Kukak Bay, Kadiak Island, and Popof Island and Unga Island of the Shumagin group. This paper contains an enumeration of the species collected at these localities. Except where otherwise stated, the numbers representing localities are those of the collections made by the writer.

The list of Chlorophyceæ, except the Oedogoniaceæ which were determined by Dr. K. E. Hirn, was prepared by Mr. F.

S. Collins. Most of the Oscillatoriaceæ were determined by Dr. Maurice Gomont, and the list of Bacillariaceæ is entirely the work of Professor A. M. Edwards. Acknowledgment is also due Dr. F. R. Kjellman, who examined many of the Alarias and the species of *Fucus* and named the entire collection of Corallinaceæ; to Dr. W. A. Setchell for examining several species of *Laminaria* and Cyanophyceæ; and to Dr. W. G. Farlow for determining several species of the Rhodophyceæ. My thanks are also due to Dr. C. E. Bessey for the loan of valuable books, to Professor Conway MacMillan for library and herbarium privileges and for the loan of books, and to Miss Josephine E. Tilden for the privilege of examining material, preserved in fluid, of her entire Puget Sound collection.

In this paper are catalogued 380 species of algæ, of which nine are new to science and 240 new to Alaska.

The number of species, both fresh water and marine, in each of the six classes of algæ is:

	FRESH WATER.	MARINE.	TOTAL.
Schizophyceæ	26	2	28
Conjugatæ	96	0	96
Chlorophyceæ	18	26	44
Phæophyceæ	0	70	70
Rhodophyceæ	1	68	69
Bacillariaceæ	32	41	73

GEOGRAPHIC DISTRIBUTION.

Though the algal flora of the Pacific coast is not well enough known to enable a map showing the exact distribution of species to be made, yet, enough collecting has been done to indicate the general distribution.

The Cyanophyceæ, Chlorophyceæ, Bacillariaceæ and the single freshwater species of the Rhodophyceæ (*Batrachospermum vagnum*) are so largely cosmopolitan that they have been disregarded in the table which follows. Of the remaining 126 species, comprising the Phæophyceæ and Rhodophyceæ, only seven are found on the southern California coast, 37 occur on the central California coast, 68 range from Puget Sound northward into Alaska waters, 49 are peculiar to the Pacific coast of North America, and 55 are either circumpolar or inhabitants

of the north Atlantic. Furthermore, of the 126 species, 39 are reported from Bering Sea, and of these, 18 are circumpolar or north Atlantic forms and 21 are peculiar to the Pacific coast of North America.

At least three distinct regions may be distinguished in the algal flora of the Pacific coast of North America; a southern, a Californian, and a northern.

The southern region extends from Point Conception southward, perhaps to the equator. It is characterized by *Nerco-cystis giganteus*, *Sargassum agardianum*, *Taonia linnbackeræ*, *Zonaria tournfortii* and many other tropical species.

The Californian region extends from Point Conception on the south, to Puget sound on the north, and is characterized by forms like *Dictyoncuron*, *Postelsia*, *Laminaria sinclairii*, *Laminaria andersonii*, and *Fucus harveyanus*. It may more properly be limited on the north by the mouth of the Columbia River and the shore line between that point and Puget Sound may be regarded as a transitional area.

The northern region begins at Puget Sound and extends northward to and including Bering Sea. It is characterized by such species as *Odonthalia aleutica*, *Polysiphonia bipinnata*, *Euthora cristata*, *Rhodymenia pertusa*, *Constantinea rosamarina*, *Fucus evanescens megacephalus*, *Agarum turneri*, *Cymathere triplicata*, *Laminaria bongardiana*, *Laminaria bulbata*, *Dictyosiphon feniculaceus*, and *Myclophycus intestinalis*.

GEOGRAPHIC DISTRIBUTION OF ALASKAN ALGÆ ON THE
PACIFIC COAST.

Names. ¹	Southern California to Alaska.	Central California to Alaska.	Puget Sound to Alaska.	From Dixon En- trance northward.	Circumpolar or North Atlantic.	Peculiar to the Pa- cific Coast of North America.	British Columbia.	Bering Sea.
<i>Streblonema minutissima</i>								
<i>Streblonema pacifica</i>						*		
<i>Streblonema irregularis</i>						*		
<i>Phycocelis baltica</i>				*	*			
<i>Ectocarpus tomentosus</i>		*			*			
<i>Ectocarpus confervoides</i>	*				*			
<i>Pylaiella littoralis</i>			*		*			*
<i>Sphacelaria cirrosa</i>				*	*			*
<i>Sphacelaria racemosa arctica</i>				*	*			*
<i>Homeostroma undulata</i>				*	*			
<i>Homeostroma latifolia</i>	*				*			
<i>Homeostroma lobata</i>				*				
<i>Punctaria plantaginea</i>				*	*			*
<i>Phyllitis fascia</i>		*			*			*
<i>Scytosiphon lomentarius</i>	*				*			*
<i>Scytosiphon bullosus</i>		*				*		*
<i>Coilodesme californica</i>		*				*		*
<i>Coilodesme bulligera</i>			*		*			
<i>Coilodesme linearis</i>				*		*		
<i>Myelophycus intestinalis</i>			*			*		
<i>Colpomenia sinuosa</i>	*				*			
<i>Soranthra ulvoides</i>		*				*		*
<i>Elachista lubrica</i>				*	*			
<i>Dictyosiphon feniculaceus</i>			*		*			*
<i>Desmarestia aculeata</i>		*			*			*
<i>Desmarestia viridis</i>		*			*			
<i>Liebmannia</i> sp.....			*					
<i>Eudesme virescens</i>				*	*			
<i>Myrionema strangulans</i>		*	*		*			
<i>Mesogloia simplex</i>			*					
<i>Chordaria flagelliformis</i>					*			
<i>Chordaria abietina</i>		*				*		
<i>Ralfsia deusta</i>				*	*			*
<i>Ralfsia clavata</i>	*				*			
<i>Chorda filum</i>				*	*			
<i>Alaria cordata</i>			*			*		
<i>Alaria fragilis</i>				*		*		
<i>Alaria laticosta</i>				*		*		*
<i>Alaria lanceolata</i>				*		*		*
<i>Alaria fistulosa</i>				*		*		*
<i>Laminaria bullata</i>		*			*	*		*
<i>Laminaria bongardiana</i>		*		*	*	*		*
<i>Laminaria cuneata</i>				*	*			
<i>Laminaria solidungula</i>			*	*	*			
<i>Laminaria saccharina</i>		*			*			
<i>Hedophyllum sessile</i>		*	*			*		
<i>Hedophyllum subsessile</i>		*	*	*		*		
<i>Cymathere triplicata</i>		*	*			*		*

¹ Black face type indicates new species.

Names.	Southern California to Alaska.	Central California to Alaska.	Puget Sound to Alaska.	From Dixon En- trance northward.	Circumpolar or North Atlantic.	Peculiar to the Pa- cific Coast of North America.	British Columbia.	Bering Sea
<i>Pleurophycus gardneri</i>			*			*		
<i>Thalassiophyllum clathrus</i>				*		*		*
<i>Eisenia arborea</i>		*				*		
<i>Macrocyctis pyrifera</i>		*				*		
<i>Nereocystis prapus</i>		*				*		
<i>Agarum turneri</i>			*		*			*
<i>Agarum gmelini</i>				*		*		
<i>Costaria mertensii</i>		*				*		
<i>Fucus evanescens</i>			*		*			
<i>Cystophyllum lepidum</i>			*			*		
<i>Bangia atropurpurea pacifica</i>						*	*	
<i>Porphyra laciniata</i>				*	*			*
<i>Porphyra perforata</i>	*							
<i>Porphyra amplissima</i>					*			
<i>Porphyra miniata cuneiformis</i>		*			*			
<i>Porphyra tenuissima</i>				*	*			
<i>Choreocolax polysiphonicea</i>				*	*			
<i>Endocladia muricata</i>		*				*		
<i>Iridæa membranacea</i>			*			*		
<i>Iridæa laminarioides</i>						*	*	
<i>Gigartina papillata</i>		*				*		
<i>Gigartina pacifica</i>				*		*		
<i>Kalymenia californica</i>		*				*		
<i>Ahnfeldtia plicata</i>		*			*			
<i>Turnerella mertensiana</i>		*				*		
<i>Euthora cristata</i>			*		*			
<i>Rhodomenia pertusa</i>			*		*			
<i>Rhodomenia palmata</i>				*	*			
<i>Plocamium coccineum uncinatum</i>				*	*			
<i>Halosaccion fucicola</i>			*			*		*
<i>Halosaccion ramentaceum</i>				*	*			
<i>Halosaccion firmum</i>				*		*		*
<i>Halosaccion tilesii</i>				*		* ?		*
<i>Halosaccion microsporum</i>			*		*			
<i>Nitophyllum ruthenicum</i>				*		*		*
<i>Delesseria bærii</i>			*		*			
<i>Delesseria alata</i>				*	*		*	
<i>Delesseria sinuosa</i>				*	*			*
<i>Delesseria crassifolia</i>								*
<i>Delesseria serrata</i>								
<i>Rhodomela floccosa</i>		*				*		*
<i>Rhodomela larix</i>		*			* ?			*
<i>Odonthalia aleutica</i>			*			*		*
<i>Odonthalia kamtschatica</i>				*		*		*
<i>Polysiphonia bipinnata</i>			*			*		*
<i>Polysiphonia arctica</i>				*	*			
<i>Calithamnion floccosum pacificum</i>		*				*		
<i>Calithamnion plumula</i>							*	
<i>Calithamnion pikeanum</i>		*			*			
<i>Ptilota asplenoides</i>				*				*
<i>Ptilota plumosa</i>				*	*			

Names.	Southern California to Alaska.	Central California to Alaska.	Puget Sound to Alaska.	From Dixon En- trance northward.	Circumpolar or North Atlantic.	Peculiar to the Pa- cific Coast of North America.	British Columbia.	Bering Sea.
<i>Ptilota serrata</i>				*	*			
<i>Antithamnion boreale</i>				*	*			*
<i>Ceramium rubrum</i>		*			*			*
<i>Ceramium codicola</i>		*				*		
<i>Microcladia borealis</i>		*				*		
<i>Rhodochorton rothii</i>		*			*			
<i>Gloiosiphonia furcata</i>			*			*		*
<i>Gloiosiphonia californica</i>								
<i>Cryptonemia obovata</i>			*			*		
<i>Dumontia filiforme</i>				*	*			
<i>Cryptosiphonia grayana</i>			*			*		
<i>Dilsea californica</i>	*					*		
<i>Dilsea arctica</i>				*	*			*
<i>Constantinea rosa marina</i>			*			*		*
<i>Hildenbrandtia rosea</i>		*			*			*
<i>Melobesia patens</i>				*				
<i>Lithophyllum farlowii</i>		*				*		
<i>Lithophyllum compactum</i>				*	*			
<i>Lithophyllum glaciale</i>				*	*			
<i>Lithothamnion leve</i>				*				
<i>Clathromorphum circumscriptum</i>				*				
<i>Lepidomorphum yendoi</i>				*		*		
<i>Amphiroa tuberculosa</i>				*		*		*
<i>Amphiroa epiphlegmoides</i>				*		*		
<i>Amphiroa planiuscula</i>				*				
<i>Corallina arbuscula</i>		* ?				*		
<i>Corallina pilulifera filiformis</i>				*		*		

CATALOGUE OF SPECIES.

SCHIZOPHYCEÆ.

Family *CHROOCOCCACEÆ*.**Chroococcus turgidus** (Kuetz.) Naegeli.

Distributed through a mass of *Microcystis marginata* which formed a slimy coating on a perpendicular cliff over which water was trickling. Juneau (75).

Chroococcus rufescens (Bréb.) Naegeli.

Forming with *Stigonema* a reddish coating on a rock five hundred feet above sea level. Prince William Sound (Trelease 501).

Schizothrix lardacea (Cesati) Gomont.

Forming bright rose-red tufts on rocks exposed to fresh water spray, near Orca, Prince William Sound (304). Identified by Gomont.

Schizothrix lacustris A. Braun.

In a freshwater pool with *Stigonema* near Prince William Sound (300). Identified by Setchell.

Microcoleus vaginatus (Vaucher) Gomont.

Forming, with *Scytonema mirabilis*, a thin coating on damp ground recently covered by snow. Glacier Bay (104).

Family *NOSTOCACEÆ*.**Nostoc commune** Vaucher.

Forming thin leathery thalli of indefinite size and shape on damp ground near Glacier Bay (106); Hidden Glacier, Yakutat Bay (502).

Cells spherical or oblong, 12–18 μ in diameter; often two to four cells coalesced. Tegument colorless; cytoplasm finely granulated.

Aphanothece microspora Naegeli.

Forming with *Chroococcus turgidus* a slimy coating on a perpendicular cliff over which water was trickling. Juneau (75).

Microcystis marginata Naegeli.

Forming a slimy coating on a perpendicular cliff near Juneau (75).

Dermocarpa prasina Born. & Thur.

Abundant on *Sphacelaria racemosa arctica* and *Sphacelaria cirrosa*. From Puget Sound to the Shumagin Islands.

Dermocarpa fucicola sp. nov. (Plate XLVI, figs. 4 and 5.)

Phyotheca Boreali-Americana, No. 801.

Plant forming dark violet brown patches 2–12 mm. in extent; cells 40–60 μ high, 18–25 μ broad, ovate, clavate or spatulate, much narrowed below; schizospores abundant. On *Fucus evanescens megacephala*, Puget Sound (440). Forming orbicular or irregular patches which become confluent into irregular masses of indefinite extent.

This plant is closely related to Savageau's *D. biscayensis*, but differs from it in the larger size of the patches and the shape and size of the individual cells. In *D. biscayensis* the plant forms orbicular patches 1 mm. broad and the cells are 25–30 μ broad.

Family *OSCILLATORIACEÆ*.**Oscillatoria amœna** (Kuetz.) Gomont.

The plant formed a soft, felt like, dark bluish-green mass 3–10 mm. thick, of indefinite extent, lining the bottom of the outlet of a hot spring. The water in the outlet where the plant was abundant ranged from 80° F. some distance from the spring to 120° F. near the spring. Near Sitka (158). Identified by Gomont.

Phormidium autumnale (Ag.) Gomont.

Forming a thin dark blue coating on small rocks in a rapid stream emptying into Kukak Bay (332). Identified by Gomont.

Phormidium laminosum (Ag.) Gomont.

Forming a thin membranaceous stratum on perpendicular rocks moistened by spray from a waterfall, Orca (301). Identified by Gomont.

Lyngbya ærugineo-cærulea (Kuetz.) Gomont.

In a felt-like mass of filaments of *Vaucheria*.

Juneau (74); with *Zygnema* sp. in a small pond on an island in the Muir Glacier (107).

Nostoc sphæroides Kuetz.?

Forming a soft bluish green coating on rocks near Juneau (75).

This species was submitted to Dr. Setchell, who says of it "The *Nostoc* is a minute spherical one very often found but I am uncertain as to whether it is *N. sphæroides* or not."

Desmonema wrangelii (Ag.) Bor. & Fla.

Mixed with *Tolypothrix tenuis* from a clear brook emptying into Glacier Bay (103). In a similar locality and associated with the same species on Popof Island (404).

Family *SCYTONEMACEÆ*.**Scytonema varium** Kuetz.

On rocks moistened by spray from a waterfall near Juneau (76). Identified by Setchell.

Scytonema myochrous (Dillw.) Ag.

With *Tolypothrix tenuis*, forming small tufts on rocks in a brook emptying into Glacier Bay. Identified by Setchell.

Scytonema mirabile Bornet.

On moist ground near Glacier Bay, with *Microcoleus vaginatus* (104). On the perpendicular surface of a rock, with *Vaucheria*, moistened by dripping water, Kukak Bay (347).

Scytonema figuratum Ag.

In a freshwater stream emptying into Glacier Bay (103 b).

Tolypothrix tenuis Kuetz.

Forming brownish or blue-green tufts attached to rocks in fresh water. Glacier Bay (300); Popof Island (404). Identified by Setchell.

Family *STIGONEMATACEÆ*.**Hapalosiphon pumilus** (Kuetz.) Kirchner.

In a freshwater pond near Seldovia, Cook Inlet (424).

Stigonema minutum (Ag.) Hassall.

Forming a thin brown coating with *Chroococcus rufescens* on damp rocks several hundred feet above sea level, Prince William Sound (Trelease 501).

The threads are about 1 mm. high, 13–25 μ broad, irregularly branched and flexuously curved; sheath yellowish brown; internal tegument much darker; main filament usually of one layer of cells; the branches usually of two or more; heterocysts abundant, yellowish, lateral or intercalary.

Stigonema ocellatum (Dillw.) Thur.

On rocks in a rapid stream emptying into Glacier Bay; floating in a quiet freshwater pool, Prince William Sound (300, 302).

The plant forms dark brown, loosely caespitose tufts 2–7 or 8 mm. high which are attached at first but finally are floating; irregularly branched, branches elongated, patent, primary filaments one or two cells thick (35–50 μ) all bearing hormogones; trichomes 21–40 μ broad; sheath broad, indistinctly lamellose, yellowish brown except near the ends on young branches; cells 25–35 μ , shorter than broad, surrounded by a dark brown tegument; heterocysts lateral, scarce; hormogones 13 μ broad, 50–65 μ long.

Family *RIVULARIACEÆ*.**Calothrix fusca** (Kuetz.) Bornet.

Imbedded in the gelatinous coating of *Batrachospermum vagum* from a freshwater pond, Cook Inlet (423); Kadiak Island (504).

The plants, which were apparently immature, resemble the form of *C. æruginosa* of Kuetz.¹ The threads are loosely gregarious, broad, curved and somewhat enlarged at the base; sheath broad, ochraceous with age, produced into long thread-like articulations; heterocysts 10 μ broad.

Calothrix scopulorum (Weber & Mohr) Ag.

In salt water, Puget Sound.

Rivularia biasolletiana Menegh.

On rocks in freshwater streams, Juneau (76); Glacier Bay (102). Identified by Setchell.

¹ Kuetz. Tab. Phyc. 2: Pl. 45, Figs. 5 and 6.

The plant forms minute, hard, dark bluish green thalli 1-3 mm. in diameter, which finally become agglutinated into hollow indefinite masses.

Family *HYDRURACEÆ*.

Hydrurus penicillatus Ag.

Plant forming dark olive-green filaments attached to smooth round pebbles in a rapid brook emptying into Kukak Bay (351).

The filaments are 7-20 mm. in length, having long primary branches bearing many short penicillate ones.

CONJUGATÆ.

Family *DESMIDIACEÆ*.

Mesotæniun braunii De Bary. (Plate XLIII, fig. 29.)

In a freshwater pond near Cook Inlet.

The cells are cylindrical, $2\frac{1}{4}$ times as long as broad; 16 to 18 μ broad, 38-45 μ long.

Penium interruptum Bréb.

In a freshwater pond near Seldovia, Cook Inlet.

Plant 24-40 μ wide, 130-145 μ long. Slightly smaller in all its dimensions but agrees otherwise with the description.

Penium closterioides Ralfs.

In a freshwater pond on Popof Island.

Diameter 140 μ , length 150 μ .

Penium margaritaceum (Ehrenb.) Bréb.

Occasional in freshwater, Kukak Bay.

Cells 25 μ wide, 100 μ long.

Penium polymorphum Perty.

In quiet water near Kukak Bay.

Cells 22 μ wide, 35 μ long. Very delicately punctate-striate.

Penium oblongum De Bary.

In a freshwater pond near Virgin Bay, Prince William Sound (302).

Diameter 21 μ , length 64 μ .

Penium digitus (Ehrenb.) Bréb. (Plate XLIV, fig. 3.)

In quiet water, Virgin Bay. Rare.

Diameter 54 μ , length 183 μ . The plant averages almost a third

smaller in all its parts than the measurements given by various authorities.

Closterium juncidum Ralfs.

In quiet water near Seldovia, Cook Inlet (422).

Diameter 10μ , length 240μ . The plant is slightly bent, but little contracted toward the ends, which are obtusely rounded; membranes smooth, light brown; vacuoles not apparent.

Closterium angustatum reticulatum Wolle.

Occasional in a freshwater pond near Cook Inlet.

Diameter $16-19\mu$, length 340μ . The plant is dark brown, marked with delicate longitudinally and spirally arranged striæ.

Closterium acerosum (Schrank) Ehrenb. (Plate XLIII, fig. 27.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $18-29\mu$, length $200-300\mu$.

Virgin Bay, Prince William Sound.

Diameter 29μ , length $265-300\mu$.

Closterium striolatum Ehrenb.

In quiet water in Kukak Bay (283).

Diameter $25-30\mu$, length $275-300\mu$.

Closterium brebissonii Delp.

In a freshwater pond near Cook Inlet (224).

Diameter 18μ , length 650μ .

Closterium lunula (Muell.) Nitzsch.

Occasional in quiet water near Kukak Bay.

Diameter 70μ , length 450μ .

Closterium acutum (Lyngb.) Bréb.

In a freshwater pool near Prince William Sound (300).

Diameter $8-9\mu$, length $85-100\mu$. The plant is small and slightly bent, ten times as long as broad, tapering from the middle to the rounded ends; cytoderm smooth and colorless.

Closterium dianæ Ehrenb.

Freshwater pool, Prince William Sound (302). Only one specimen seen.

Diameter 16μ , length 180μ .

Closterium venus Kuetz. (Plate XLIII, fig. 15.)

In a pond near Seldovia, Cook Inlet (422).

Diameter 9μ , length 85μ .

Closterium parvulum Naeg. (Plate XLIII, fig. 14.)

Very abundant in freshwater pond near Seldovia, Cook Inlet (424)
Diameter 8–12 μ , length 100 μ .

Tetmemorus brebissonii (Menegh.) Ralfs.

In freshwater near Prince William Sound: frequent.

Diameter 23 μ , length 78 μ .

Tetmemorus lævis (Kuetz.) Ralfs.

In a freshwater stream, Virgin Bay (300); Yakutat Bay.

Diameter 21–24 μ , length 91–100 μ . The plant is slightly constricted and not at all punctate.

Pleurotænium nodosum (Bail.) Lund.

Common in a freshwater pond, Popof Island.

Diameter 40–45 μ , length 290–325 μ .

Pleurotænium truncatum (Bréb.) Naeg.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 45 μ , length 216 μ .

Disphinctium cucurbita (Bréb.) Reinsch.

In a freshwater pond near Prince William Sound (302).

Diameter 27 μ , length 67 μ .

Disphinctium connatum (Bréb.) DeBary. (Plate XLIII, fig. 30.)

In a freshwater pond near Seldovia, Cook Inlet. Only one specimen was seen.

Diameter 24 μ , length 38 μ .

Docidium baculum Bréb.

In a freshwater pond, Popof Island.

Diameter 27 μ , length 228 μ . The plant is slightly wider than the description given, but is not at all narrowed as are the other species.

Docidium coronulatum Grun.

In a freshwater pool near Kukak Bay.

Diameter 40 μ , length 432 μ .

Docidium dilatatum (Cleve.) Lund.

In a freshwater pond, Popof Island.

Diameter 13 μ , length 165 μ . The plant has five pearly granules at each end.

Docidium gracile Wittr.

Triploceras gracile BAIL. Micr.

Common in fresh water near Prince William Sound.

Diameter 27 μ . The plant has two rows of rather long spines.

Docidium minutum Ralfs.*Pleurotænium?* *minutum* (Ralfs.) Delponte.

In freshwater near Prince William Sound.

Diameter $11\ \mu$, length $135\ \mu$.**Arthrodesmus convergens** Ehrenb. (Plate XLIV, fig. 14.)

In a freshwater pond near Seldovia, Cook Inlet (422). Rare.

Diameter $32\ \mu$, length $32\ \mu$ without the spines.**Xanthidium antilopæum** (Bréb.) Kuetz. (Plate XLIII, fig. 38.)

In a freshwater pond near Cook Inlet.

Diameter $55\ \mu$, length $55\ \mu$ including the spines. The spines near the apex of the semi-cells are more nearly straight than in the figures given of this species.**Xanthidium armatum** (Bréb.) Ralfs. (Plate XLIV, fig. 18.)

In a freshwater pond near Virgin Bay, Prince William Sound.

Diameter $81\ \mu$, length $128\ \mu$. Most of the spines are bifurcated, with the points divergent.**Cosmarium granatum** Bréb. (Plate XLIII, fig. 8.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $18\ \mu$, length $32\ \mu$.**Cosmarium constrictum** Delp. (Plate XLIII, figs. 33, 34.)

In a freshwater pool near Virgin Bay, Prince William Sound (300).

Diameter $40\ \mu$, length $65\ \mu$.**Cosmarium bioculatum** Bréb. (Plate XLIII, fig. 28.)

Common in a freshwater pond, Seldovia, Cook Inlet (422).

Diameter $16\text{--}18\ \mu$, length $17\text{--}18\ \mu$.**Cosmarium hammeri** Reinsch. (Plate XLIII, fig. 7.)

In a freshwater pond near Seldovia, Cook Inlet (422).

Diameter $10\text{--}14\ \mu$, length $18\text{--}22\ \mu$. Very close to the variety *subangustatum* of Boldt. The angles are a little more acute than in the type; the apex of the semicells is very emarginate.**Cosmarium depressum** (Naeg.) Lund. (Plate XLIII, fig. 17.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $16\text{--}20\ \mu$, length $18\ \mu$.**Cosmarium holmiense** Lund. (Plate XLIV, fig. 28.)

In freshwater near Kukak Bay.

Diameter $32\ \mu$, length $54\ \mu$.**Cosmarium venustum** (Bréb.) Arch.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $18\ \mu$, length $27\ \mu$. In its measurements the Alaskan plant agrees with Nordstedt's variety *induratum* but has the form of the type.

Cosmarium latum Bréb. (Plate XLIV, fig. 4.)

In a freshwater pool near Kukak Bay.

Diameter $68\ \mu$, length $100\ \mu$.

Cosmarium contractum Kirch. (Plate XLIV, fig. 16.)

In freshwater near Kukak Bay.

Diameter $22\ \mu$, length $22\ \mu$.

Cosmarium sexangulare Lund. (Plate XLIII, fig. 39.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $27\ \mu$, length $32\ \mu$.

Cosmarium tumidum Lund. (Plate XLIV, fig. 21.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 27 – $30\ \mu$, length 35 – $38\ \mu$. Several specimens were found, all of which belong to Kirchner's variety *subtile*, the cytoderm being delicately punctate over the whole surface.

Cosmarium parvulum Bréb. (Plate XLIII, fig. 6.)

In freshwater, Virgin Bay, Prince William Sound.

Diameter 17 – $19\ \mu$, length 35 – $38\ \mu$. Some of the specimens have a smooth cytoderm and on some it is delicately punctate.

Cosmarium kitchellii Wolle. (Plate XLIV, fig. 17.)

In a freshwater pond Seldovia, Cook Inlet.

Diameter $43\ \mu$, length $51\ \mu$. The plant agrees in all three views with Wolle's description except that the three central rows of granules are neither longer nor more conspicuous than the marginal ones.

Cosmarium pyramidatum Bréb. ? (Plate XLIII, fig. 40.)

In a freshwater pool near Juneau; Kukak Bay.

Diameter $35\ \mu$, length $54\ \mu$, isthmus $11\ \mu$ wide; cell membranes very delicately punctate.

Cosmarium pachydermum Lund. (Plate XLIV, fig. 12.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $73\ \mu$, length $103\ \mu$.

Cosmarium undulatum Corda. (Plate XLIV, fig. 9.)

In a freshwater pond near Seldovia, Cook Inlet (422).

Diameter $38\ \mu$, length $59\ \mu$; cytoderm smooth, edge crenate, ten crenæ to a semicell; sinus enlarged outward.

Cosmarium pseudogranatum Nordst. (Plate XLIII, fig. 21.)

In a freshwater pond, Popof Island.

Diameter 35 μ , length 51 μ .

Cosmarium botrytis Menegh. (Plate XLIII, fig. 11.)

In freshwater, Popof Island.

Diameter 35-43 μ , length 40-52 μ .

Cosmarium conspersum Ralfs. (Plate XLIII, fig. 1.)

In a freshwater pond, Cook Inlet (424).

Cosmarium cælatum Ralfs. (Plate XLIII, fig. 2.)

In a freshwater pond, Glacier Bay; only one specimen seen.

Diameter 40-45 μ .

Cosmarium portianum nephroideum Witttr. (Plate XLIII, figs. 12, 13.)

Freshwater pond, Seldovia, Cook Inlet.

Diameter 21 μ , length 32 μ ; isthmus 9 μ broad; sinus 5 μ wide.

The verrucæ are short, absent from the sinus.

Cosmarium ochtodes Nordst. (Plate XLIII, fig. 10.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 64 μ , length 97 μ .

Cosmarium intermedium Delp. (Plate XLIV, fig. 1.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 74 μ , length 66 μ , isthmus 12 μ wide. The plant is covered all over with large pearly granules.

Cosmarium subcrenatum Hantzsch. (Plate XLIII, fig. 20.)

In freshwater ponds, Glacier Bay; Kukak Bay.

Diameter 26-30 μ , length 35-40 μ .

Cosmarium phaseolus Bréb. (Plate XLIV, fig. 8.)

In freshwater near Seldovia, Cook Inlet.

Diameter 24 μ , length 27 μ ; sinus 3 μ broad; isthmus 4 μ broad.

Cosmarium costatum Nordst.

In freshwater near Virgin Bay, Prince William Sound.

Diameter 40 μ .

Cosmarium pulcherrimum Nordst. (Plate XLIII, figs. 18, 19.)

In freshwater near Kukak Bay.

Diameter 38 μ , length 52 μ .

Cosmarium quadrifarium Lund. (Plate XLIII, fig. 22.)

In freshwater near Virgin Bay, Prince William Sound.

Diameter 33 μ , length 40 μ .

Cosmarium broomei Thwaites. (Plate XLIII, figs. 26, 35, 36.)

In freshwater, Popof Island.

Diameter 40 μ , length 40 μ .

Cosmarium ornatum Ralf. (Plate XLIII, fig. 3.)

Very abundant in a freshwater pond, Kukak Bay; Cook Inlet.

Diameter 32–45 μ , length 38–75 μ .

Cosmarium sphaerostichum Nordst. (Plate XLIV, fig. 6.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 16 μ , length 16 μ .

Cosmarium pseudotaxichondrum Nordst. (Plate XLIII, fig. 5.)

In freshwater ponds near Prince William Sound.

Diameter 33 μ , length 22 μ .

Pleurotæniopsis pseudoconnata (Nordst.) Lagerh.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 27 μ , length 38 μ . The sinus is broad and very shallow and the margins distinctly striate; cytoderm finely punctate; the end view a perfect circle and the chlorophyll body divided into eight equal arms.

Pleurotæniopsis debaryi (Archer) Lund. (Plate XLIV, fig. 20.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 65 μ , length 100 μ , isthmus 40 μ broad. Only one specimen was found and this agrees with Nordstedt's variety *spitsbergensis*.

Pleurotæniopsis ralfsii (Bréb.) Lund.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 54 μ , length 70 μ .

Staurastrum dejectum Bréb. (Plate XLIV, fig. 5.)

In a freshwater pond near Seldovia, Cook Inlet (422).

Diameter 21 μ , length 21 μ .

Staurastrum dejectum mucronatum (Ralfs) Kirchn.

Occurs with the type.

Diameter 27 μ , length 27 μ .

Staurastrum ravenelii Wood. (Plate XLIV, fig. 29.)

In a freshwater pond, Seldovia, Cook Inlet.

Staurastrum pygmæum Bréb.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 27 μ , length 30 μ .

Staurastrum calyxoides Wolle. (Plate XLIII, fig. 31.)

In freshwater near Prince William Sound (300).

Diameter 10 μ , length 20 μ .

Staurostrum furcigerum Bréb.

In a freshwater pond near Seldovia, Cook Inlet (422).

Diameter 45 μ , length 50 μ .

Staurostrum arcticon (Ehrenb.) Lund.

In a freshwater pool, Virgin Bay, Prince William Sound (302).
Common.

Diameter 116 μ .

Staurostrum polymorphum Bréb. (Plate XLIII, figs. 23, 24.)

In a freshwater pond near Seldovia, Cook Inlet (402).

Diameter 40 μ , length 45 μ . The end view shows four arms rounded at the ends.

Staurostrum echinatum (Perty) Rab. (Plate XLIII, fig. 16.)

In a freshwater pond near Seldovia, Cook Inlet.

Euastrum verrucosum Ehrenb. (Plate XLIII, fig. 9.)

In freshwater, Popof Island.

Diameter 81 μ , length 88 μ .

Euastrum gemmatum Bréb.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 40 μ , length 67 μ . The plant agrees exactly with Brébisson's description except that the terminal lobe is not emarginate.

Euastrum pokornyanum Grun.

In a freshwater pond near Kukak Bay.

Diameter 21 μ , length 43 μ . The basal lobe of the trilobe semicell is crenate, the terminal lobe subcuneate, truncate and excised; membrane smooth.

Euastrum oblongum (Grev.) Ralfs. (Plate XLIII, fig. 37.)

In a freshwater pond near Prince William Sound.

Diameter 67 μ , length 130 μ . The semicells are five lobed, all of the lobes having the broad shallow marginal cavity.

Euastrum crassum (Bréb.) Kuetz. (Plate XLIII, fig. 4.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 68 μ , length 148 μ .

Euastrum didelta (Turp.) Ralfs. (Plate XLIV, Fig. 24.)

In freshwater near Kukak Bay.

Diameter 46–60 μ , length 86–120 μ , sinus 16 μ deep, bridge 11 μ wide.

Euastrum ansatum Ralfs.

In a freshwater pond near Yakutat Bay.

Proc. Wash. Acad. Sci., November, 1901.

Diameter $27\ \mu$, length $54\ \mu$.

Euastrum elegans (Bréb.) Kuetz. (Plate XLIV, figs. 2, 25, 26, 30.)

Common in freshwater near Yakutat Bay; Prince William Sound; Popof Island.

Diameter $13\text{--}15\ \mu$, length $20\text{--}30\ \mu$.

Euastrum affine Ralfs. (Plate XLIII, fig. 32.)

In freshwater material from Glacier Bay.

Diameter $60\ \mu$ wide, length $121\ \mu$.

Micrasterias truncata (Corda) Ralfs. (Plate XLIV, fig. 7.)

In a freshwater pond near Glacier Bay.

Diameter $92\ \mu$, length $97\ \mu$.

Micrasterias oscitans pinnatifida (Kuetz.) Rabenh. (Plate XLIV, fig. 27.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $60\ \mu$, length $60\ \mu$. Plant is considerably smaller than the measurements given by various authors but agrees perfectly as to shape and markings.

Micrasterias rotata (Grev.) Ralfs. (Plate XLIII, fig. 25.)

In a freshwater pond, Prince William Sound.

Diameter $190\text{--}220\ \mu$. The plant varies considerably in the length of the processes on the ultimate division of the semicells.

Micrasterias denticulata (Bréb.) Ralfs. (Plate XLIV, fig. 11.)

In a freshwater pond near Kukak Bay.

Diameter $90\ \mu$, length $110\ \mu$.

Micrasterias fimbriata elephanta Wolle. (Plate XLIV, fig. 31.)

In freshwater pond near Seldovia, Cook Inlet.

Diameter $350\ \mu$, length $350\ \mu$.

Micrasterias kitchellii Wolle. (Plate XLIV, fig. 23.)

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $135\ \mu$, length $135\ \mu$.

Sphærozozma excavatum spinulosum (Del Ponte) Hansg.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $8\text{--}10\ \mu$, length $11\ \mu$.

Desmidium swartzii Ag.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter $35\ \mu$.

Gymnozyga (?) longata (Wolle) Nordst.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 35 μ .

Family *ZYGNEACEÆ*.¹

Spirogyra varians (Hass.) Kuetz.

In a freshwater pond near Seldovia, Cook Inlet.

Diameter 38-40 μ .

Spirogyra porticalis (Muell.) Cleve.

In running water, Popof Island.

Diameter of the zygospores 32-42 μ .

CHLOROPHYCEÆ.

Family *PLEUROCOCCACEÆ*.

Oocystis solitaria crassa (Wittr.) Hansgirg.

Forming a mucous coating on damp rocks near waterfalls. Juneau (75). Identified by Setchell.

Family *PROTOCOCCACEÆ*.

Sphærella lacustris (Girod.) Wittr.

On snow near Yakutat Bay, June 23.

This is the so-called "red snow" found in standing rain water and on snow throughout Europe and North America. It was also observed by members of the party on Muir Glacier and on snow above Orca, Prince William Sound.

Family *HYDRODYCTIACEÆ*.

Pediastrum boryanum (Turp.) Menegh.

In freshwater, Popof Island.

Pediastrum angulosum (Ehrenb.) Menegh.

Abundant in a freshwater pond, Popof Island.

The plant is discoidal, 32-celled, the cells all angled.

Family *ULVACEÆ*.

Monostroma fuscum (Post & Rupr.) Wittr.

On rocks, Muir Inlet, Glacier Bay (105); Sitka (144); Virgin Bay, Prince William Sound (277); Kukak Bay (315); Lowe Inlet (16).

¹ Several sterile specimens of *Zygnema* were collected, but no fruiting material was obtained.

Fronde 40–60 μ thick, dark green, becoming brownish or blackish when dried, not adhering to the paper; cells in cross-section usually longest at right angles to the surface of the frond.

In the Kukak Bay specimens the frond is about 40 μ thick, and the cells are nearly square in cross section, agreeing with the typical *M. fuscum*. In the Lowe Inlet specimen the frond is 30 μ thick, the cells in cross section somewhat rounded, agreeing with the form known as *M. splendens*. The color however is duller than usual in that form.

***Monostroma vahlii* J. Ag.**

Kukak Bay (316).

Fronde persistently tubular, torn at the top so as to form a flat membrane only at a quite late stage; thickness of membrane 15–25 μ ; cells about 12 μ in cross section, somewhat arranged in series when seen from the surface.

This species has much resemblance in habit to the genus *Enteromorpha*, at least when young.

***Monostroma grœnlandicum* J. Ag.**

Kukak Bay (346).

Fronde filiform, opening only at the extreme top, when in fruit; thickness of membrane 25–30 μ ; cells roundish-angular seen from surface, radiately elongate in cross-section.

Externally the frond of this species is that of a slender, unbranched *Enteromorpha*, but the structure is that of *Monostroma*. It has heretofore been found only in the Arctic region and along the Atlantic coast, from Greenland to Nahant, Massachusetts. The specimens from Kukak Bay have cells little more than half the size of those in Greenland and New England specimens, otherwise there is no difference.

***Ulva lactuca rigida* (J. Ag.) Le Jolis.**

Fronde usually ovate when young, later becoming of indefinite shape, rather firm.

Common in quiet pools, Virgin Bay, Prince William Sound (278); Shumagin Islands (396).

A very common species, varying in form, texture and dimensions, distributed all over the world.

***Ulva lactuca myriotrema* Le Jolis.**

On rocks and algæ, Sitka (133).

Fronde pierced with numerous irregular holes. Rather a form than a definite variety.

***Enteromorpha linza* (L.) J. Ag.**

Yakutat Bay (232).

Frond flattened, the membranes united except for a small space at the margin.

Enteromorpha linza *forma lanceolata* J. Ag.

Yakutat Bay (232).

Margins smooth and even.

Enteromorpha linza *forma crispata* J. Ag.

Sitka (156).

Margins and often the whole frond crisped and wavy.

This species connects the genera *Enteromorpha* and *Ulva* and has perhaps been oftenest placed in the latter; but its affinities seem to be more with the present genus.

Enteromorpha intestinalis (L.) Link.

Metlakatla, Annette Island (37).

Frond simple or with a few proliferations at the base, usually enlarged upward; cells arranged in no definite order, 6–12 μ wide, in cross section radiate, 16–30 μ long, the membrane about twice as thick as the cell length in cross section.

Enteromorpha intestinalis *forma cylindracea* J. Ag.

In a protected sandy pool, Kukak Bay with *forma maxima* (316); Sand Point, Popof Island (382).

The frond is long, slender, and of nearly uniform diameter throughout its length.

Enteromorpha intestinalis *forma maxima* J. Ag.

Orca (311); Kukak Bay, with *forma cylindracea* (316); Victoria, British Columbia, a form with small cells and thin membrane, approaching *E. minima* (12).

Frond much inflated, usually contorted.

Enteromorpha micrococca Kuetz.

On cliff, Orca (305); Shumagin Islands (398).

Frond simple, tubular, of small size, much contorted; cells 4–5 μ in diameter; in membrane 18–20 μ thick.

This species usually grows in dense masses on rocks between tide marks.

Enteromorpha prolifera (Muell.) J. Ag.

Annette Island (35).

Frond more or less abundantly branched; branches like main frond, not much smaller; cells arranged in longitudinal series in all but the oldest parts of the frond.

These specimens have few branches.

Enteromorpha crinita (Roth) J. Ag.

Wrangell (65); Sitka (155); Prince William Sound (309).

Frond abundantly branched, usually with a main stem and virgate branches, with cells in longitudinal series, beset with short, tapering ramuli, the smallest of a single series of very short cells.

In specimens from this last locality the habit is that of *E. intestinalis* forma *cylindracea*, but the structure and the branching are those of *E. crinita*.

Family *ULOTHRICHACEÆ*.**Ulothrix flacca** (Dillw.) Thuret.

Glacier Bay (82). Very abundant, forming a dark green coating on rocks and pebbles on the shore, extending up to within a quarter of a mile of the glacier.

Cells one-sixth to two-thirds as long as broad; filaments 20–40 μ in diameter.

Hormidium parietinum (Vauch.) Kuetz.

Yakutat Bay; St. Paul, Kadiak.

Cells one-fourth to one diameter in length, often dividing into two or more lateral series, which may develop into a flat membrane.

As now understood, *H. parietinum* includes two forms that were long considered distinct species, and that in their fully developed condition are of quite different habit,—the filiform *Ulothrix parietina* and the membranaceous *Prasiola crispa*. In the specimens collected at Yakutat both forms are to be found, each apparently usually occurring by itself, but both sometimes together. The frond of the *Prasiola* may reach several millimeters in width. The species occurs on damp ground, not like most other algæ, submerged.

Family *ÆDOGONIACEÆ*.¹**Oedogonium concatenatum** (Hass.) Wittr.

Popof Island.

This species was reported by Wolle from Pennsylvania and New Jersey; I have also observed it in material from Malden, Mass.

Bulbochæte brebissonii Kuetz.

In a freshwater pond near Seldovia, Cook Inlet.

This species has not been hitherto known to occur in America. The form reported by Wolle does not belong to this species.

¹This family was determined by Dr. K. E. Hirn, of The Royal University of Finland, whose notes are here given in translation.

Bulbochæte intermedia De Bar.

In a freshwater pond near Seldovia, Cook Inlet.

This species according to Wolle is generally distributed throughout the United States. Wittrock records it from north Greenland.

Bulbochæte nordstedtii Wittr.

In a freshwater pond near Seldovia, Cook Inlet.

This species has also been reported by Wittrock from Greenland. I have also found it from Norwich, Conn.

Bulbochæte nana Wittr.

In a freshwater pond, Shumagin Islands.

Reported from north Greenland.

The form which Wolle refers to this species belongs, it seems to me, according to his figures, to *B. monile*.

Bulbochæte insignis Pringsh.

Wolle reports this species as occurring in many lakes in New Jersey.

Family *CLADOPHORACEÆ*.**Trentepohlia iolithus** (L.) Wallr.

Orca, on rocks at 1,000 feet elevation (Trelease).

Forming an orange or brick-red coating on rocks; filaments dichotomously or irregularly branched; cells 14–20 μ thick in the middle, much constricted at the ends, $1\frac{1}{2}$ to 2 times as long as broad, thick-walled. This is the *Veilchenstein* of the Germans. It grows on rocks, requires little moisture and can withstand prolonged drouth. When moistened it has a distinct violet odor.

Urospora penicilliformis (Roth) Aresch.

Phycotheca Boreali-Americana, No. 18.

Forming a light green coating on cliffs, Kukak Bay (349).

Frond 20–60 μ in diameter; cells from one-third to three diameters in length, usually constricted at the nodes.

Chætomorpha cannabina (Aresch.) Kjellm.

Annette Island (46), filaments light green, more curled than usual, generally 80–110 μ in diameter; Cook Inlet, near Seldovia (417), less curled, and filaments coarser than in the previous specimens.

Filaments light green, 80–150 μ in diameter; cells 1 to 4 times as long as broad.

Chætomorpha melagonium forma rupicola (Aresch.) Kjellm.

Yakutat Bay (243).

Filaments dark green, attached at base, 300–500 μ in diameter; cells $1\frac{1}{2}$ to 3 times as long as broad.

A large and rather coarse species, abundant throughout the whole Arctic region, and as far south as the cold currents extend in the Atlantic and the Pacific.

Rhizoclonium riparium implexum (Dillw.) Rosenvinge.

Yakutat Bay (192), floating in large flocculent masses.

Rather light green in color; filaments 20–30 μ in diameter; cells 1 to 5 times as long as broad.

In these specimens the filaments reach a diameter of 30 μ ; the cells are sometimes five times as long as broad. No rhizoidal branches were noted, thus placing the form as variety *implexum*. It is difficult to distinguish this variety technically from species of *Chaetomorpha*, but all forms of *Rhizoclonium* have a certain irregularity in form of the cells, which is readily recognized when one becomes familiar with these plants.

Cladophora arctica (Dillw.) Kuetz.

Glacier Bay (91); Ocean Cape, entrance to Yakutat Bay, on rocks (233); near Sand Point, Popof Island (381).

Filaments 40–90 μ in diameter, straight and rather stiff; branches erect; basal parts, especially in older plants, emitting numerous slender rhizoidal descending filaments, by which the whole tuft is matted together.

Cladophora scopæformis (Rupr.) Harv.

Yakutat Bay (225); Sitka, on exposed rocky points (185); Kukak Bay (320, 327), on rocks exposed to direct washing of the waves.

Filaments 100–200 μ in diameter, straight and stiff; branches erect, all but the youngest parts attached to each other by short hooked branches, forming long, simple or branching, slender tufts, from 2 to 10 mm. in diameter.

This is a characteristic species of the coast from California northward, resembling a larger and coarser *C. arctica* in its later stages.

Cladophora flexuosa (Griff.) Harv.

Filaments pale green, flexuous, sparingly branched, 20–60 μ in diameter; cells 2 to 3 times as long as broad; ultimate ramuli short, curved, usually secund.

The determination of these specimens is based on their resemblance to No. 206. Alg. Am.-Bor. Exsicc. The species is found on both

sides of the Atlantic, but appears not to have been previously reported from the Pacific.

The following specimens of *Cladophora* can be noted by numbers only, specific determination being impracticable at present.

Annette Island (17, 45, 48); Wrangell (56); on rocks, Glacier Bay (86); forming masses on rocks, Sitka (157); on protected side of exposed rocks, Virgin Bay, Prince William Sound (295).

Family *GOMONTIACEÆ*.

Gomontia polyrhiza (Lagerh.) Born. & Flah.

Popof Island.

Basal layer growing in the substance of marine shells, erect filaments extending to the surface, zoöspores formed in sporangia.

Family *DERBESIACEÆ*.

Derbesia vaucheriæformis (Harv.) J. Ag.

On a sponge in Yakutat Bay (234).

Filaments 30–40 μ in diameter, simple below, dichotomous above, branches patent, 20–30 μ wide, often with a cuboidal cell near the base; zoösporangia ovoid or pyriform, 140–200 by 50–80 μ , short-pediced.

As there are no mature spores on this specimen, there is a possible doubt as to the identification, but the characters agree well with the species named.

Derbesia marina (Lyng.) Kjellm.

Sitka, in quiet water (149).

Filaments 50–60 μ in diameter at the thickest, tapering slightly; sparingly branched laterally, usually two partitions found at the base of each branch, enclosing a short cell; zoösporangia 150–180 by 90–120 μ , short pedicled.

Family *VAUCHERIACEÆ*.

Vaucheria sessilis (Vauch.) DC.

On an overhanging dripping cliff, Juneau (74).

Filaments up to 70 μ in diameter; oögonia usually two or three together, sessile, ovate or ovate-oblong, about 60–150 μ , beaked; antheridia in the vicinity of the oögonia, formed at the end of a short, hooked or curved ramulus.

With antheridia and oögonia.

Family *CODIACEÆ*.**Codium adhærens** (Cabr.) Ag.

Dredged at Kadiak, at 15 meters depth (350). This species usually grows between tide marks and its occurrence at this depth is exceptional.

Forming flat expansions, adherent by the lower surface.

Codium mucronatum californicum J. Ag.

Sitka (170).

Forming a terete, dichotomously branching, fleshy, erect thallus; filaments tipped with a short mucron.

Family *CHARACEÆ*.¹**Chara contraria** A. Braun.

In ponds and streams near Glacier Bay, very abundant (300).

Chara fragilis Desv.

In a freshwater pond, Shumagin Islands (400).

Nitella acuminata subglomerata A. Braun.

In a fresh water pond near Prince William Sound (300).

Nitella opaca Ag.?

In a freshwater pond near Kadiak (419).

PHÆOPHYCÆÆ.Family *ECTOCARPACEÆ*.**Phycocelis baltica** (Reinke) Foslie.

Forming minute tufts one mm. or less in diameter on *Ralfsia deusta*. Sitka (169a).

The erect filaments are unbranched, 200–300 μ long by 5–7 μ wide; cells 8–10 μ long; plurilocular sporangia 60–80 μ long, 6–9 μ wide, borne on a 3–5-celled stalk, containing 20–30 uniseriate zoöspores.

Streblonema minutissima sp. nov. (Plate XLV, fig. 3.)

Plant composed of penetrating filaments ramifying through the cortical filaments of the host, from which arise short erect filaments intermingled with the peripheral filaments of the host, which are once or twice dichotomously branched bearing above a few short branches that become transformed into uniseriate plurilocular sporangia 20–30 μ long by 3–5 μ wide.

¹ Determined by Dr. T. F. Allen.

In the branches of *Liebmannia* sp. from Sitka (1426).

A very minute plant the erect branches of which might easily be taken for a part of the host plant. The penetrating filaments are 1–2 μ wide, short, sparingly branched; cross partitions few and inconspicuous, at intervals closely applied to the host cells; no hairs or unilocular sporangia were observed.

***Streblonema pacifica* sp. nov.** (Plate XLV, fig. 1a and 1b.)

Plant composed of irregular branching horizontal threads, from which arise mostly unicellular, haustoria-like filaments which penetrate into the host plant, and erect filaments arising at right angles to the horizontal ones; cells of the horizontal filaments 4–8 μ wide, twice as long as the diameter; erect filaments short, unbranched or once dichotomous, 30–70 μ long, most of them bearing a narrow elliptical plurilocular sporangium 5 μ and 13 μ , which contains about five uniseriate zoöspores. The plant forms circular dark brown patches 2–4 mm. in diameter on the sporophylls of *Alaria*. Related to *Streblonema minutulum* of Heydrich, but larger in all its measurements.

Yakutat Bay (438).

***Streblonema irregularis* sp. nov.** (Plate XLV, fig. 2.)

Plant consisting of irregularly branching surface filaments applied closely to the host plant, from which arise numerous simple or sparingly branched erect filaments 1–2 mm. high, 9–14 μ wide, cells as long to twice as long as broad; from the surface filaments, filaments 10–14 μ wide, with cells a little shorter or longer than broad, penetrate the substratum irregularly; plurilocular sporangia linear, lanceolate or ovate, terminal or lateral on the erect filament, 14–18 μ wide, 55–70 μ long; no unilocular sporangia observed.

Forming small brown patches on the bulbs of *Nereocystis priapus*, Sitka (164).

This plant is closely related to *Streblonema stilophorea* in its general appearance and method of branching, but differs from it in the shape of the sporangia and the chromatophores of the vegetative filaments which are small, round and numerous in this species.

***Ectocarpus tomentosus* (Huds.) Lyngb.**

Abundant on *Fucus evanescens*, Sitka harbor (166), and Victoria, British Columbia (49).

The rope-like tufts of the Alaskan specimens are fully as long as those from the Atlantic ocean, while the specimens from the California coast are rarely over three mm. in length.

Ectocarpus confervoides (Roth) Le Jol.

On rocks in Yakutat Bay (226½).

This plant comes very close to the typical form of the species, it is 10 or more centimeters long, closely intertwined, the branches few, aterminal, and secund, 20–40 μ broad at the base, the ultimate ones short and pointed; plurilocular sporangia ovate, sessile or short stalked, borne laterally on the main branches, especially abundant on the short ultimate ones, 20–30 μ , by 40–80 μ long.

Ectocarpus confervoides corticulatus Saunders.

Ectocarpus corticulatus SAUNDERS, Phyc. Mem. 152. pl. 20.

On *Desmarestia aculeata*, Popof Island (368).

This species is the same as that described from the California coast though the tufts are longer, and only the main filaments and the lower part of the long primary filaments are uniformly corticated. After examining a large amount of material of this and several other varieties of *E. confervoides* the writer is convinced that *E. corticulatus* should be considered as a variety of *E. confervoides*.

The plant is of a light olive green, forming flocculent tufts a few mm. to 5 cm. or more in length, the main filament and lower part of the primary branches densely corticated, 60–100 μ broad, ultimate branches short, bearing numerous ovate plurilocular sporangia 16–25 μ broad, and 40–70 μ long.

Ectocarpus confervoides pygmæus (Aresch.) Kjellm.

Forming a velvety covering or minute tufts on various algae, from Puget Sound to the Shumagin Islands. Yakutat Bay (439); Shumagin Islands (386).

The plant is 2–15 mm. high, sparingly branched; filaments 10–20 μ broad, 2 to 3 times as long.

Pylaiella littoralis (L.) Kjellm. *acuta*, form. nov.

Plant 3–10 cm. or more long, loosely disposed; main filaments 25–40 μ wide, branches few, alternate or opposite, ultimate filaments short, pointed, but not pilate; unilocular sporangia in the ultimate branches 18–24 μ broad, 5–15 or more in a chain.

This plant agrees with the variety *opposita* Kjellm. in its general appearance but is smaller in all its parts and is not pilate.

Very abundant from Wrangell westward to the Aleutian Islands. Kukak Bay (322).

The plants form large loose tufts on *Fucus evanescens macrocephala* and occasionally on rocks in all quiet coves. In several instances it was found extending up brooks much beyond the mean tide level. In

fact it seemed to be most abundant and to reach its best development in quiet waters at the mouths of brooks where the percent of salt must be perceptibly reduced.

***Pylaiella littoralis varia* (Kjellm.) Kuck.**

Common on rocks, and on *Fucus* and other algæ in quiet water from Puget Sound to Bering Sea. Victoria, Juneau, Yakutat and Shumagin Islands.

This form is 1-10 cm. in length, a light faded brown in color, very intricate, the ultimate branches short and standing at right angles to the axis.

***Pylaiella littoralis densa* Saunders.**

The plant forms rope-like masses 2-4 cm. or more long on *Fucus* and other algæ. Victoria, Sitka, Prince William Sound (294), Shumagin Islands (386).

***Pylaiella littoralis macrocarpa* (Foslie) Kjellm.**

On fruiting tips of *Fucus evanescens macrocephalus*, Victoria.

The plant is 1-3 mm. or more long, the branches and the upper part of the main filament, except for a few-celled stalk at the base and one of the cells at the tip, form plurilocular sporangia. No unilocular sporangia were observed.

Family *SPHACELARIACEÆ*.

***Sphacelaria cirrosa* (Roth) Ag.**

Forming small light olive tufts on *Fucus evanescens*, Annette Island.

***Sphacelaria racemosa arctica* (Harv.) Reinke.**

Wrangell (70); Yakutat Bay (195); Prince William Sound (283).

Forming dark olive-brown, densely tufted mats sometimes several cm. wide and 1 cm. high; unilocular sporangia abundant on all material collected at the various stations.

Family *ENCOELIACEÆ*.

***Homeostroma undulatum* J. Ag. (Plate XLVI, fig. 3.)**

On *Zoostera marina* in a quiet cove near Seldovia, Cook Inlet (412).

Fruiting plants 3 cm. long, 1-3 mm. wide.

The plurilocular sporangia project little if at all above the surface of the plant and are massed together more than is indicated in Reinke's figures. The single hairs are very scarce on all the Pacific coast material.

Homeostroma lobatum sp. nov. (Plate XLVI, figs. 6a, 6b, 6c.)

Plant broadly linear, lanceolate or ovate, 10 or more cm. long, 1-5 cm. wide, narrowed below to a short stipe, dark olive-brown; the edges deeply and irregularly lobed, the lobes irregularly cut and divided; unilocular sporangia scattered over the whole surface of the plant.

Attached to *Zostera marina*. Sitka (114); Prince William Sound (296).

Cross sections of the young plants were two cells thick, those of the older plants 4 cells thick, the central cells slightly larger than the outer but not at all elongated. No plurilocular sporangia were observed.

Homeostroma latifolium (Grev.) J. Ag.

Occasional in quiet sandy coves. Annette Island (39); Sitka (143); Popof Island (367).

Punctaria plantaginea Grev.

On exposed rocks near entrance to Yakutat Bay (229).

The plant is 4-10 mm. wide, and 5-10 cm. long. Both unilocular and plurilocular sporangia are abundant. Some of the specimens approach Foslie's variety *linearis*.¹

Myelophycus intestinalis sp. nov. (Plate XLVII.)

Plant dark reddish brown, loosely caespitose, cylindrical, hollow with age, much twisted and intestiniform, narrowed below to a distinct solid stipe, 5-12 mm. long; the inner layer of tissue composed of long colorless cells, the intermediate layer composed of 2-4 irregularly arranged rows of thick-walled cuboidal cells giving rise to broad coarse paraphyses composed of 4-8 thick-walled cells; sporangia very abundant, elliptical or obovate, scattered irregularly throughout the frond, 45-60 μ long, 20-30 μ wide, arising like the paraphyses from the intermediate layer of tissue.

Attached to rocks in the sublittoral zone from Puget Sound to the Shumagin Islands. More abundant in quiet coves. Glacier Bay (113); Sitka (192); Yakutat (252); Popof Island (359); Puget Sound (Gardner 215).

This plant was at first referred tentatively by the writer to Foslie's *Chordaria attenuata*. Foslie states² however that this plant is a form of *Scytosiphon*; Mr. F. S. Collins has kindly examined specimens of Foslie's plant and agrees that it is a *Scytosiphon* and quite distinct from the Pacific plant. *M. intestinalis* is less firm in texture and is lighter colored than Kjellman's *M. caespitosa*; in cross section the

¹Foslie, Om Nogle Arctiske Havalger.

²Nya Havalger, Vol. 13: 97.

paraphyses are much broader and shorter, and the sporangia broader than in *M. cæspitosa* and the central layer of tissue composed of only 2-4 rows of cells while in *M. cæspitosa* there are 10 or more rows.

The plant so closely resembles *Scytosiphon lomentarius* in color and general appearance that it has probably been passed over by collectors. It is however somewhat firmer in texture and not at all constricted. Specimens collected from Puget Sound averaged much smaller than those collected farther north. From Sitka northward the plant is more abundant than *Scytosiphon lomentarius*.

Scytosiphon lomentarius (Lyngb.) J. Ag.

Abundant, Puget Sound; Annette Island (40); Glacier Bay; Sitka (892); Yakutat Bay (2290); Kukak Bay; Shumagin Islands (360).

Scytosiphon lomentarius complanatus Rosenv.

Juneau; Glacier Bay (98).

Scytosiphon bullosus Saunders.

On rocks in the sublittoral zone, Sitka (145); Cook Inlet (408).

Heretofore this species was known only from the type locality, Monterey Bay. (Am. Alg. 251.)

Phyllitis fascia (Muell.) Kuetz.

Abundant in protected places in the littoral zone from Puget Sound to the Shumagin Islands. Annette Island (41); Glacier Bay (94); Yakutat Bay (220); Kukak Bay (319); Cook Inlet (409, 410).

The specimens from the northern localities are much larger than the average plant from the California coast and the Atlantic coast of North America. Those from Cook Inlet are 20-35 cm. long and 2-4 cm. wide.

Colpomenia sinuosa (Roth) Derb. & Sol.

On *Cystophyllum lepidum*, Prince William Sound (268); Yakutat Bay (420).

This widely distributed and usually common species was seen but twice during the trip. It is common in quiet coves from Puget Sound to southern California.

Coilodesme linearis sp. nov. (Plate XLVIII.)

Phycotheca Boreali-Americana No. 824.

Plant linear, tubular, olive brown, 8-20 cm. long, narrowed below to a short stalk (1-2 mm. long); tissues thin and delicate, composed of three to four layers of cells; unilocular sporangia scattered singly throughout the plant, 11-14 μ wide, 15-20 μ long.

On *Cystophyllum lepidum*, Popof Island (399); Kukak Bay (320½).

The plant is attached to the host in great numbers. It differs from *C. californica* in its shape, size and the size of the unilocular sporangia. The tissue is more delicate, being composed of from two to three layers of colorless cells, a single row of endodermal cells and one of poorly differentiated epidermal cells.

Coilodesme californica (Rupr.) Kjellm.

Occasional on *Systophyllum lepidum* from Puget Sound to Yakutat Bay. Victoria; Annette Island (38); Wrangell (58); Yakutat Bay (224).

No fruiting plants were seen, but the shape and structure of the specimens obtained are the same as in those of the California coast. It is much less abundant in southern Alaska than on the shores of California and apparently is wholly replaced further north by *C. linearis*.

Coilodesme bulligera Stroemf.

Abundant on rocks in the littoral zone in quiet coves, from Puget Sound to the Aleutian Islands. Wrangell (58); Yakutat Bay (222); Prince William Sound (282, 312); Kukak Bay (345½); Shumagin Islands (390a).

Soranthra ulvoides Post & Rupr.

Saunders, Phyc. Mem. 165. Pl. 29, fig. 4 and 5.

Abundant in the littoral and sublittoral zone, in rather quiet protected places, on rocks, *Rhodomela larix*, and *Rhodamea floccosa*. Victoria (2); Wrangell (69, 120, 162); Yakutat Bay.

Family *DESMARESTIACEÆ*.

Desmarestia viridis (Muel.) Lamour.

In the ellittoral and sublittoral zones, Glacier Bay (110); Prince William Sound (274); not uncommon but less abundant than the next species.

Desmarestia aculeata (L.) Lamour.

One of the most abundant of plants in the ellittoral and sublittoral zones from Puget Sound to the Aleutian Islands. Victoria (8); Sitka (180½); Wrangell; Yakutat Bay (226½); Kukak Bay (322½); Shumagin Islands (369).

Family *DICTYOSIPHONACEÆ*.

Dictyosiphon fœniculaceus (Huds.) Grev.

A common plant on rocks, *Scytosiphon* and other plants from Puget Sound to Bering Strait. Annette Island (42); Wrangell (59);

Juneau (72); Prince William Sound (285); Shumagin Islands (341); Glacier Bay (96).

Family *ELACHISTACEÆ*.

Elachista lubrica Rupr.

Phycotheca Boreali-Americana No. 828.

On *Rhodymenia palmata* in the littoral zone. Wrangell (66); Glacier Bay (83) (101); Prince William Sound (306); Yakutat Bay (242).

Family *CHORDARIACEÆ*.

Myrionema strangulans Grev. (Plate XLVI, figs. 1, 2.)

On *Ulva lactuca*. Sitka (146). Abundant also on the California coast.

Eudesme virescens (Carm.) J. Ag.

Not uncommon on rocks and *Zostera marina* in the sublittoral and littoral zones. Sitka (115-177); Glacier Bay (194); Shumagin Islands (406½); Prince William Sound (284).

The specimens from Prince William Sound are somewhat doubtfully referred to this species. The plant is much smaller than the other specimens, much more branched throughout and of a light yellow color, resembling in these respects Zanardini's *E. flavescens*. The microscopic structure however is identical with that of *E. virescens*.

Leathesia difformis (L.) Aresch.

On rocks and algæ in the littoral zone from Puget Sound to the Shumagin Islands. Victoria (2½); Annette Island (32); Wrangell (70½); Sitka (142); Yakutat Bay (254).

Mesogloia simplex sp. nov. (Plate L, figs. 3, 4.)

Plant soft mucous, olive-brown, unbranched, tubular or intestinal-form, hollow, rounded above, narrowed below to a short indistinct stipe; central filaments few, distinct, irregularly branched; peripheral filament short, simple, 2-3-4-celled; unilocular sporangia ovate or elliptical, pyriform, 15-25 μ by 25-35 μ , arising from the subcortical area.

In structure this plant very closely resembles *Gobia*, agreeing closely with Gobi's figure and description, but lacks the parenchymatous structure of that genus. It is no doubt one of the *Chordariaceæ*, which is given this somewhat provisional name until the plurilocular sporangia are found.

Attached to old worn plants of *Chordaria abietina*. Sitka (128).

Small immature specimens of this plant are also found on the specimens of *Chordaria abietina*, from Puget Sound, distributed by Miss J. E. Tilden (Am. Alg., No. 348).

Chordaria flagelliformis (Muell.) Ag.

Abundant in protected places in the sublittoral zone, attached to rocks and to other algæ. Sitka (122); Glacier Bay (96); Yakutat Bay (193, 231).

The plant has frequently been reported from the Atlantic shores of Europe and America, the Baltic Sea, the Arctic Ocean, and the shores of Kamchatka.

Chordaria abietina Rupr.

Attached to rocks in exposed places in the littoral zone. Sitka (126)? Prince William Sound (291); Shumagin Islands (380).

This species is much less abundant than on the California coast and all specimens collected are smaller than the average plant of the species from that region.

? **Liebmannia** sp. (Plate XLIX.)

A single specimen of a *Mesogloia*-like plant was collected at Sitka (142a). It bears an abundance of unilocular but no plurilocular sporangia, hence its exact position is in doubt. The arrangement and structure of the axial tissue and the peripheral filaments closely resemble those of *Liebmannia*.

Family *RALFSIACEÆ*.

Ralfsia deusta (Ag.) J. Ag.

Sitka (169); Kukak Bay (324) Orca, Prince William Sound (267a).

The plants were loosely attached to rocks in the sublittoral zone. All specimens collected were sterile.

Ralfsia clavata (Carm.) Farl.

Yakutat Bay and Cook Inlet (413½).

Forming light olive-green patches 5-10 mm. in diameter, which finally produce an indefinite coating on rocks; in the sublittoral region.

Family *LAMINARIACEÆ*.

Chorda filum (L.) Lamour.

Found in the sublittoral region. Prince William Sound (273); Popof Island (383).

At both stations the plant was found in quiet sandy coves in great abundance.

***Alaria fragilis* sp. nov.** (Plate LIV.)

Plant of small size (4–8 dm. long); blade lanceolate or linear, undulate on the margin, 1–2 dm. broad, substance thin membranaceous, brittle, drying dark; midrib quadrangular in cross section, protruding equally on each margin; stipe short, rounded at base, slightly flattened above, 7–12 cm. long; rachis 6–15 cm. long, slightly flattened but no broader than the stipe; sporophylls few (8–18), distant, oblong elliptical, often oblique at the base, very obtuse above, narrowed below to a stalk (5–15 mm. long); sporangia confined to the basal third of the sporophyll.

Dr. Kjellman compares this plant to Harvey's specimen labeled *Alaria pylaii* Grev.¹ from Vancouver Island, but he agrees that Harvey's specimen is distinct from *Alaria pylaii* of the Atlantic and Polar Seas and is an undescribed species. This plant differs essentially from the description of *A. pylaii* in having a longer stipe and the sporophylls few and distinct.

In the sublittoral zone. Glacier Bay (80½); Prince William Sound (257); Kukak Bay (333½).

***Alaria fragilis* forma *bullata* form. nov.**

With the last, Glacier Bay (79).

With this species were collected several specimens that agree with it except that the blade is densely covered with small bullations, occasionally a plant being found that had only a very few or almost no bullations. It may be a distinct species but it seems preferable to regard it as a bullate form of the last until it can be further studied.

***Alaria laticosta* Kjellm.** (Plate LV.)

In the sublittoral zone, in protected coves, Kukak Bay (333).

Plant of medium size, 1–2 mm.; stipe short, round, 2–5 mm. long; rachis long muriculate, slightly broader than the stipe; lamina broadly linear, dark brown, drying blackish, undulate on the margin, plicated and fluted, 10–20 cm. broad, tapering below to the transition point, midrib 7–12 mm. broad; sporophylls numerous, long and narrow, rounded at end, gradually narrowed to a short indistinct stalk, fruit usually confined to the lower two-thirds of the sporophyll, varying in size, 10–30 cm. long, 1–2 cm. wide, and borne on a stalk 4 mm. long.

Dr. Kjellman referred the plants sent him to this species with some doubt. He says: "The form, color and consistency of the blade, and the form, width and rigidity of the sporophyll differ somewhat from this species."

¹ Harvey's Notes Col. Alg. N. W. Coast, 165.

***Alaria lanceolata* Kjellm.** (Plate LIII.)

In the sublittoral zone. Glacier Bay (111); Sitka Harbor (178).

The specimens obtained agree well with Kjellman's description, and specimens submitted to him were pronounced to be this species, which is easily recognized by the tufts of long cryptostomata which in no other species are so large and abundant.

***Alaria cordata* Tilden.** (Plate LVI.)

In the sublittoral zone on exposed point of an island opposite the entrance to Yakutat Bay (230). The plant was growing in great abundance at this station but was not seen again on the trip.

The writer's specimens are certainly identical with Miss Tilden's plant, of which, by her kindness, he has seen both herbarium and formalin specimens. There is also in the writer's herbarium a young plant of this species, from Puget Sound, collected by Mr. N. L. Gardner and labelled by Dr. Setchell *Alaria esculenta* ?.

The stipe is of medium length (15 cm.), round, dark and firm; rachis short and broad. The blade is oblong, lanceolate (250-450 cm. long), somewhat undulate, plicate, light olive-green, firm; midrib protruding equally on both sides; medulla slightly swollen near the margins; sporophylls few (7-10 on a side), arising seriatly on a short stalk, broadly linear, ovate, cuneate or somewhat cordate at the base; obtuse or occasionally acute above, sporangia covering most of the surface, 25-40 cm. long, 3-6 cm. wide.

***Alaria fistulosa* Post & Rupr.** (Plate LVII.)

The first specimen of this large and interesting plant was a fragment of the midrib washed ashore near Wrangell. At Juneau several much worn specimens were obtained but no plants were found *in situ*. In Glacier Bay it was abundant from the lower part of the sublittoral zone to a quarter of a mile from the shore. Although some immature plants measured 12 feet in length the plant does not reach the size nor is it as abundant as farther north. In Yakutat Bay, Prince William Sound, and Cook Inlet a few fragments were found washed ashore but no mature specimens were seen growing. This may be due to the fact that all landings were made in protected places in the bays while this plant loves considerable exposure. Near the mouth of Kukak Bay there are numerous reefs 5-10 fathoms or more below the surface. These reefs are marked by patches of this species, sometimes an acre or more in extent. The plant not only reaches the surface but floats for several meters on the surface.

The plant is of a very dark olive-brown color, the blade being broadly linear, thin, papery, and smooth, 2-8 or 10 dm. broad; the

midrib is 15-40 or more mm. broad, the central part inflated, and divided by narrow septa into air vesicles of various lengths; near the base of the blade the septa become indistinct and then disappear, the inflations also disappear some distance above the transition point; the stipe is short (5-10 cm. long), black, solid, and rounded at the base, flattened above and gradually passing into the rachis, which is broad and short; sporophylls very numerous, crowded, spatulate, elliptical or obovate, rounded at the ends and narrowed below to a stipe of considerable length (2-4 cm.); fruiting area covering nearly the entire surface of the sporophyll.

No complete specimens of mature plants were measured but many fragments were cast ashore having a blade which measured 3-7 meters in length and 4-10 dm. in width.

De Toni¹ credits this species, on the authority of Dr. Anderson, to California. Dr. Anderson informed the writer that he had seen no specimens from the California coast and had no record of its occurrence there. He admitted that several of the *Laminariaceæ* credited in his list to the northern coast of California had been included in the belief that they might occur there.

Pleurophycus gen. nov. Setchell & Saunders. (Plate LII.) Plant attached to the substratum by hapteres, consisting of a single undivided blade with one central distinct midrib; no perforations or auricles at the base of the blade; stipe simple; muciferous canals wanting; fruiting area confined to the midrib; sporangia and paraphyses as in *Laminaria*.

Pleurophycus gardneri sp. nov. Setchell & Saunders. (Plate LII.)

Tilden's Am. Alg., No. 346.

Blade broadly linear in outline, tapering below to the transition point, 7-12 dm. and more long, 12-25 cm. wide, thin and soft, striate and "lung like," wrinkled or somewhat regularly pleated near the midrib giving it a bullate appearance which disappears near the base of the blade; midrib broad (3-7 cm.) and flat, 2 mm. thick, narrow above and below; stipe dark brown, drying black (3-7 dm.), firm and solid, round below, much flattened above and gradually passing into the midrib; sorus single, covering the upper part of the midrib.

Yakutat Bay (236); Puget Sound (450).

On June 26, 1899, on an island opposite the entrance to Yakutat Bay the writer collected a few fragments of a plant washed up with severa

¹ Syll. Alg. 3: 322.

species of kelp that he at once took to represent a new genus. The locality was visited for three successive mornings during the lowest tides and although an abundance of material was washed ashore the plant was not found *in situ*. Several other points in the bay were visited but no sign of the plant was found. If it grows off the shore on which it was collected, and the condition of the material collected would indicate that it does, it must grow well down in the elittoral zone, for twice a careful search was made along the whole shore line at the lowest tide, where one could get out beyond the "kelp line." The location in which the plant was collected and the frayed and torn condition of the ends of the blade would indicate that it grows in exposed localities. In all specimens collected the stipe was broken off apparently just above the holdfast. The only holdfast seen was on an almost perfect specimen (from which Plate LII was drawn) collected by Miss J. E. Tilden in Puget Sound.

Pleurophycus has no midrib in a proper sense, but has a broad shallow furrow indented on one surface and prominent on the other, the surface of which is little thicker than that of the adjacent portion of blade, except in the region of the sorus.

This plant was first collected by Mr. N. L. Gardner in Puget Sound in the summer of 1898 and sent to Dr. Setchell for identification. Dr. Setchell recognized it at once as a new genus and gave it the above manuscript name. The writer not knowing of Dr. Setchell's name gave his specimen a provisional name, but on learning from Mr. Gardner of a previous name offered his specimens for comparison to Dr. Setchell, who at once suggested the joint authorship of the name.

Referring to the distribution of the plant Dr. Setchell writes "while *Pleurophycus* may grow in the elittoral zone, all the evidence in Gardner's and my possession shows that it extends even to the upper sublittoral, as is the case with so many species credited to the elittoral, Gardner found them just below low water mark, but in places much exposed to the fury of the waves. Several of Gardner's specimens have holdfasts which show several whorls of hapteres branched in a somewhat irregularly dichotomous fashion and several times, the distal branches being slender.

Pleurophycus stands as the simplest of the subtribe *Agareæ*, forming something of a transition between that subtribe and the *Laminariæ*.

***Laminaria bullata* Kjellman.**

In the sublittoral zone. Puget Sound; Sitka (188); Prince William Sound.

All specimens collected were quite young and sterile but agree with Kjellman's figures and descriptions.

Laminaria bongardiana P. & R.

Abundant in the sublittoral zone, from Sitka to Shumagin Islands. Sitka (186); Prince William Sound; Kukak Bay (337).

Laminaria solidungula J. Ag.

Occasional in the sublittoral zone from Yakutat Bay northward and westward. Yakutat Bay (260); Kukak Bay (337); Popof Island (387½).

All specimens collected were sterile and of small size; the blade averages 6 dm. long, 3 dm. broad; the stipe is about 17 cm. broad, firm, thick and abundantly supplied with mucous canals as are the broad flattened rhizoids which are fused almost to the tips to form a disk-like attachment.

Laminaria cuneifolia J. Ag.

Two specimens of this species were collected from a small rock on Popof Island (387). The rock had apparently been washed up from the sublittoral zone. The blade is very distinctly wedge-shaped, thin, papyraceous, light olive-green, and very brittle in drying, quite regularly wavy on the margin; the stipe is black, very firm, rounded below and slightly flattened above, 6–10 cm., the rhizoids are long and slender, resembling those of *L. saccharina*.

Laminaria saccharina (L.) Lam.

Abundant in the sublittoral zone from Puget Sound to the Shumagin Islands. Two forms were collected.

Forma (a). Blade 300–800 cm. long, cuneate at base, 20–40 cm. wide; stipe 3–5 cm. long, texture thin, papyraceous or membranaceous, drying light-green; sori usually small, 1–3 dm., irregular, confined to the upper part of the frond; muciferous canals small, abundant in blade and stipe.

Glacier Bay (77); Sitka; Wrangell (63); Yakutat Bay; Cook Inlet; Shumagin Islands.

Forma (b). Blade 50–150 cm. long, 5–10 cm. wide; stipe 1–3 cm. long, submembranaceous to coriaceous; sorus occurring as a band in the central part of the blade, extending from a few centimeters to two-thirds the length of the blade; muciferous canals abundant in blade.

Prince William Sound (259½); Kukak Bay (337).

Hedophyllum sessile (Ag.) Setchell.—(Plate LI.)

Laminaria sessilis AG., Syst. Alg., p. 270. TILDEN, Am. Alg., 344.

This species was collected in the sublittoral zone in Yakutat Bay the latter part of July.

The young plants have a short distinct flat stipe 1-2 cm. long and 5 or more mm. broad, the stipe soon disappears or becomes attached to the substratum by its whole length, the old blades are a foot or two in length, irregularly longitudinally torn above, bullate and folded in the lower part.

Hedophyllum subsessile (Aresch.) Setchell (Mss.).

Laminaria bongardiana subsessilis ARESCH., Obs. Phyc. 4: 5.

Abundant in exposed places, from Puget Sound northward. Yakutat Bay (218); Prince William Sound (259); Kukak Bay (337½).

This plant, heretofore considered a form of *L. bongardiana*, is made the type of a new genus by Dr. Setchell, on account of the prostrate rhizome. The creeping rhizome-like affair is apparent only in old, well developed plants. The stalk is always short, 1-4 or 5 cm., and in mature plants much flattened above, in old specimens being as much as 2 cm. or more wide. The blade is dark brown, thick and leathery, reaching a length of 3 or more meters. It is usually split nearly to the base into 3 somewhat equal parts each one of which is more or less irregularly cut and torn.

Cymathere triplicata (Post & Rupr.) J. Ag.

Abundant from Puget Sound to Shumagin Islands. This species is gregarious and usually found pretty well down in the sublittoral zone or in the upper part of the elittoral zone. While not of extreme size this plant forms a large part of the kelp flora in many places.

Agarum gmelini Mert. (Plate LXI.)

In the sublittoral and elittoral zones in exposed localities. This species and *Desmarestia aculeata* form the majority of the elittoral flora in many places. Prince William Sound; Yakutat Bay; Kukak Bay; Popof Island.

In mature specimens the outline is rotund or reniform and the midrib broad and flat.

Three specimens from different localities gave the following measurements.

Blade.		Stipe.		Midrib.
Length.	Width.	Length.	Width.	Width.
cm.	cm.	cm.	mm.	mm.
60	80	17	10	12
60	60	15	10	14
60	60	wanting		12

Agarum turneri (Post & Rupr.).

Abundant in the sublittoral zone. Yakutat Bay (200a); Prince William Sound (261); Popof Island.

This species differs from the last chiefly in its smaller size, more ovate outline, and the much narrower midrib. Its relationship would probably be better expressed by placing it as a variety rather than a distinct species.

Costaria turneri Grev.

Abundant in the sublittoral zone from Puget Sound to the Shumagin Islands. Victoria; Sitka (187); Yakutat Bay; Prince William Sound; Kukak Bay; Shumagin Islands.

The plant reaches a much larger size on the Alaska coast than on the California and Washington coast. Specimens were seen measuring from 180 to 220 cm. in length and 50 cm. wide at the base.

Eisenia arborea Aresch.

A broken fragment of this plant was obtained at Wrangell and several specimens were obtained in Puget Sound.

Macrocystis pyrifera (Turn.) Ag. (Plate LX.)

In the elittoral zone off rocky points and in unprotected places. Wrangell; Sitka (171, 189); Juneau.

Although a constant watch was kept for this plant it was not seen north of Sitka.

Nereocystis priapus (Gmelin) Saunders. (Plates LVIII, LIX.)

Ulva priapus GMELIN, Hist. Fucorum, 231, 1768.

Nereocystis lutkeanus MERT. FIL. in Linnæa, p. 48, 1829.

Abundant from Puget Sound to the Shumagin Islands. The plant is seldom found growing in protected places, being confined to the elittoral zone at the mouth of bays and in the open ocean from a few yards to a mile or more from shore. The plant, unlike *Macrocystis pyrifera* and *Alaria fistulosa*, does not form floating masses.

Mature plants measure from 50-70 feet long, about two-thirds of which is the long tube-like stipe with its terminal air bulb, which floats the dichotomously torn lamina on the surface of the ocean.

Mertens' statement, copied by Harvey, in which in speaking of the stipes, he says: "They are said to be 45 fathoms long," is probably not true. The writer has measured many fully-developed plants on the California, Oregon, and Washington coasts as well as on the Alaska coast and has never yet found one exceeding the above figures.

Gmelin's figures and description of *Ulva priapus* leave no doubt as to the identity of his plant although he had only an imperfect stipe.

As his description antedates Mertens' by some sixty years it seems best to the writer to reinstate the name given by him.

Family *FUCACEÆ*.

Fucus evanescens forma macrocephala Kjellm. (Plate LXII, fig. 1.)

Puget Sound; Annette Island; Wrangell; Juneau; Sitka; Glacier Bay; Prince William Sound; Cook Inlet; Kukak Bay; Shumagin Islands.

This is by far the most abundant seaweed on the northwest coast. It is found in all quiet bays and protected places from Puget Sound to Bering Sea, forming the characteristic light brown covering extending some distance above the average tide level. In many places the plant is not covered by salt water more than twice a month. It is able to thrive from the moisture in the atmosphere. This species and *Pylaiella littoralis* extend the farthest up the mouths of streams and fresh water bays.

This form is more commonly evesiculose, but there are often found indefinite vesicles just below the fruiting tip, either singly or in pairs. It is a variation of this form from Puget Sound that Dr. Setchell has referred to *F. platycarpus*, which is quite a distinct species.

Identified by Kjellman.

Fucus evanescens forma cornuta Kjellm. (Plate LXII, fig. 2.)

Juneau; Yakutat Bay (256); Prince William Sound (264a); Kukak Bay (376); Popof Island.

This form was collected in more exposed places than the last and is not nearly as common. The plant is darker colored and firmer in texture than the last, with narrower branches and fruiting tip. The fruiting tip is usually not at all inflated but in one extreme variation it is inflated 5-7 cm. long.

Cystophyllum lepidum (Rupr.) Harvy.

Victoria; Wrangell; Sitka (121, 190); Yakutat Bay; Kukak Bay; Shumagin Islands.

In slightly protected places in the littoral zone from Puget Sound to Bering Sea. Mature plants measured from 1 to 3 meters in length.

RHODOPHYCEÆ.

Family *BANGIACEÆ*.

Bangia atropurpurea pacifica J. Ag.

Specimens of this species were collected near Victoria in Puget Sound but it was not obtained in Alaskan waters.

***Porphyra laciniata* (Lightf.) Ag.¹**

On the stems of *Fucus* and on rocks in the littoral and sublittoral zone, Yakutat Bay.

All specimens obtained were sterile.

***Porphyra perforata* J. Ag.**

On rocks in the littoral and sublittoral zones, Glacier Bay (100); Sitka (130); Shumagin Islands (394).

The most abundant species.

***Porphyra amplissima* (Kjellm.) Setchell & Hus.**

On rocks in the sublittoral zone, Prince William Sound. This large and beautiful species was found growing in great abundance at this station but was not collected again.

***Porphyra miniata* forma *cuneiformis* Setchell & Hus.**

Usually found floating, occasionally attached to stems of *Nereocystis* and other algæ; Lowe Inlet (20).

***Porphyra tenuissima* (Stroemf.) Setchell & Hus.**

Abundant on rocks and also epiphytic on algæ. Sitka (148a, 137); Yakutat Bay (214).

Not previously reported from the west coast of North America.

Family *HELMINTHOCLADIACEÆ*.

***Batrachospermum vagum flagelliforme* Siridot.**

In ponds, pools and streams near Virgin Bay, Prince William Sound (299); Cook Inlet (423); Kadiak Island.

Plants collected in June and July at or near sea level bore an abundance of mature carpospores.

Family *GELIDIACEÆ*.

***Choreocolax polysiphoniæ* Reinsch.**

On the stems of *Polysiphonia* sp., Sitka (123a).

Plants collected in June bore only tetraspores. The plants are closely attached to the lower part of the main stem of the *Polysiphonia*, spherical, dark brown or black, about $\frac{1}{2}$ mm. in diameter. The tubes of the *Polysiphonia* are much deformed wherever the "parasite" is attached. The central tube is much enlarged, the surrounding ones somewhat so, the walls considerably contorted and thickened. This species has been found in the Atlantic on the European and American shores but has not been previously reported from the Pacific ocean.

¹ All specimens of the genus *Porphyra* were identified by Dr. Setchell and Mr. Hus.

Family *GIGARTINACEÆ*.*Endocladia muricata* (P. & R.) J. Ag.

On perpendicular rocks in exposed places at or above the high tide line. Wrangell (62); Prince William Sound (293); Popof Island (370). This species, so common on the California coast, is comparatively rare or local on the Alaskan coast.

Iridæa membranacea J. Ag.?

On rocks in the sublittoral zone. Sitka (125); Yakutat Bay (207); Shumagin Islands (377). This is the plant distributed from Puget Sound by J. E. Tilden as *Iridæa heterocarpa* (Am. Algæ, No. 329). The plant is abundant and evidently ranges from Puget Sound to Bering Sea.

To this species Dr. Farlow has very questionably referred a plant with small, once to twice dichotomously divided plant body. It is broadly obovate or reniform in outline, tapering below to a short stalk, entire or crenate on the margin or in the sterile plants with few or many tooth-like proliferations. Dr. Farlow says "This plant has made the tour of European algologists * * * Bornet is sure that it is a form of *Iridæa laminarioides*. It also agrees with some of Bory's specimens of that species. I must admit that having seen a series of the two species in foreign herbaria, I found that I could not tell where one began and the other ended."

The plant is smaller than any of the specimens of *Iridæa laminarioides* seen by the writer, ranging from 5 to 10 cm. in length and the primary division of the plant being 2-10 cm. broad. It is also somewhat thinner in texture, dark red in color, and lighter on the margins. The cystocarps are small and evenly distributed over the entire surface of the blade except the basal part.

Iridæa laminarioides Bory.

This plant is abundant in the sublittoral zone in Puget Sound but was not seen in Alaskan waters.

Gigartina papillata Ag. forma **typica**.

Washed ashore, Shumagin Islands (357).

A few small plants 5-8 cm. in length, were collected that are identical with the forma *subsimplax* of Setchell (Phycotheca Boreali-Americana, No. 425). Dr. Farlow states that they are identical with typical *G. papillata* given him by Agardh. Dr. Setchell in a note on the distributed form says: "Under this name is included the form figured by C. Agardh as the type."

Gigartina papillata forma **cristata** Setchell.

A single plant of this variety was collected in Kukak Bay (331a) which is apparently identical with Dr. Setchell's *cristata*. It is also very closely related to some forms of *G. mamillosa*.

Gigartina pacifica Kjellm.

On rocks in the sublittoral zone. Yakutat Bay (200); Prince William Sound (308); Shumagin Islands (358, 377).

No. 377 agrees exactly with Kjellman's figures and descriptions, the others are somewhat intermediate between *G. pacifica* and *G. papillata*.

Kalymenia californica Farlow.

In tide washings, Kukak Bay (342).

The plant collected in Kukak Bay is much smaller in all of its parts than specimens from the California coast. The proliferations are very numerous, obovate, and only 2-5 cm. long by 1-2 cm. wide.

Ahnfeldtia plicata (Hudson) Fries.

On rocks in the sublittoral zone, Yakutat Bay (250); Prince William Sound (270).

The specimens collected at both stations were sterile and had fewer and shorter branches than the typical forms but agree in structure.

Family *RHODOPHYLLIDACEÆ*.**Turnerella mertensiana** (P. & Rupr.) Schmitz.

Washed ashore in exposed places. Kukak Bay (352); Shumagin Islands (453).

The plant is oblong or ovate, fastened to rocks by a basal disk, entire or lobed on the margin, coriaceous, and of a deep dark blood-red color; several specimens were obtained 6 dec. long by 3 dec. wide.

This species was seen at only three stations in Alaska, a large specimen was seen in the herbarium of Mr. N. L. Gardner, collected in Puget Sound. There is also a small sterile specimen in the writer's herbarium, from the central Californian coast, Monterey Bay.

Euthora cristata (L.) J. Ag.

Abundant in the sublittoral zone. Seldovia, near the entrance to Cook Inlet (415); Shumagin Islands (356).

One of the most abundant of the red algæ. It is also reported from Puget Sound.

Family *RHODIMENIACEÆ*.**Rhodymenia pertusa** (P. & Rupr.) J. Ag.

On rocks in the lower part of the sublittoral zone, Yakutat Bay (205); Prince William Sound (267 and 271).

No. 271 is a smaller form and not at all pertuse.

Rhodymenia palmata (L.) J. Ag.

On rocks in the upper part of the sublittoral zone. Glacier Bay (88); Yakutat Bay (206); Prince William Sound, near Orca (310); Kukak Bay (345); Popof Island (378).

The entire form of this species seems to be the more common on the Pacific Coast, though the palmately divided form and the form with numerous proliferations are also abundant.

The plant is gathered in large quantities, dried and eaten by the Indians of the northwest coast, as is *Porphyra pertusa* by the Chinamen on the California coast.

Plocamium coccineum uncinatum J. Ag.

In the sublittoral zone, Sitka (148).

Halosaccion firmum (P. & R.) J. Ag.

In the sublittoral zone in a quiet muddy cove, Cook Inlet (414).

This species was collected at only the one station, but it was abundant there.

Halosaccion fucicola (Post & Rupr.) J. Ag.

On rocks, *Rhodomela larix*, and other algæ in the littoral zone from Puget Sound to Bering Sea. Victoria (5); Annette Island (33); Sitka (145a); Prince William Sound; Popof Island.

Halosaccion ramentaceum (L.) J. Ag.

In the sublittoral and littoral zones. Kukak Bay (331, 317); Cook Inlet (414).

Nos. 317 and 414 agree with the typical form of this variable species. No. 331 is very close to the forma *densa* of Kjellm. It was found well up in the littoral zone while the other forms are sublittoral. At each station this species was collected only once.

Halosaccion tilesii (Ag.) Kjellm.

In the littoral zone from Wrangell to Bering Sea. Wrangell (54); Yakutat Bay (235, 248, 249); Prince William Sound (306a); Kukak Bay (453).

Halosaccion microsporum Rupr.

In the littoral zone. Glacier Bay (85, 109); Yakutat Bay (452).

The three numbers, referred to this species somewhat tentatively, represent three very variable and diverse forms which however agree in structure.

Family *DELESSERIACEÆ*.

Nitophyllum ruthenicum (Post & Rupr.) Kjellm.¹

A single sterile specimen of this plant was collected in the sublittoral zone at Sitka (119).

The plant is 15 cm. high bearing many cuneate branches which are delicately longitudinally striate, especially near the base. It is quite distinct from any of the Californian species of *Nitophyllum*, but is related to *N. latissimum*. The nerves are much more delicate and not branched and disappearing above the middle of the lobes; in this respect it is intermediate between *N. latissimum* and *N. fryeanum*.

Delesseria bærii (Post & Rupr.) J. Ag.

Two small sterile plants of this species were collected in the sublittoral zone near Sitka (183).

Delesseria alata (Huds.) J. Ag.

A few sterile plants of this species were collected in Puget Sound at Victoria (3). It was not seen in Alaskan waters.

Delesseria sinuosa (Good. & Wood.) Lamour.

Abundant in the sublittoral zone. Sitka (151); Prince William Sound (265); Kukak Bay (344, 323); Shumagin Islands (371, 389).

A very variable species, some of the forms resembling *D. quercifolia* but with a more distinct midrib and opposite nerves. Specimens from Kukak Bay bore an abundance of cystocarps. The species occurs in the Arctic and North Atlantic oceans and has recently been reported by Kjellman from Bering Sea. From Sitka to the Shumagin Islands it is the most common *Delesseria*.

Delesseria crassifolia Rupr.

A specimen of this plant was collected by Prof. Trevor Kincaid in 1898 on the shores of St. Paul Island. It was not collected by the Harriman Expedition in Bering Sea.

Delesseria decipiens J. Ag.

In the sublittoral zone, Prince William Sound (290).

An abundance of cystocarpic material was collected. The plants are much smaller (only 8-15 cm. in length) than those from the California coast, but agree in other respects.

¹ Kjellman, Om Behringshaf. Algfl., 25.

Delesseria serrata Post & Rupr.

To this species is referred a plant with the general appearance of a broad form of *D. alata*, but the branches are more distant and fewer and the margins of the upper and younger branches are regularly or irregularly serrate. It may be an extreme form of *D. alata* but it seems best to keep it under a separate name until this is proven.

Family *RHODOMELACEÆ*.**Rhodomela floccosa** Ag.

In the littoral and sublittoral zones from Puget Sound to Bering Sea. Annette Island (30, 56); Wrangell (68); Sitka (139); Yakutat Bay (191, 203); Kukak Bay (321); Popof Island (374).

One of the most abundant plants. It occurs also on the Washington, Oregon, and California coasts.

Rhodomela larix Ag.

Attached to rocks in the upper sublittoral and littoral zones; abundant from Puget Sound to the Shumagin Islands. Sitka (131); Kukak Bay (318).

Odonthalia aleutica (Mertens) J. Ag.

Attached to rocks in the sublittoral zone, Shumagin Islands (385).

The same species has been collected in Puget Sound by the writer. The branches are narrower than in *O. dentata*, the perithecia are racemed and very slightly oblong-urceolate, and the plant turns black in drying.

Odonthalia kamtschatica (Rupr.) J. Ag.

On rocks in the sublittoral zone. Kukak Bay (341); Yakutat Bay (219).

In this species the plant is smaller than the last species and remains a dark blood-red color in drying: the perithecia are short, racemed and very strongly urceolate.

Polysiphonia arctica J. Ag.

In the sublittoral zone, Shumagin Islands (364, 366).

Polysiphonia bipinnata Post & Rupr.

Abundant on rocks and on other algæ in the sublittoral zone, from Puget Sound northward. Annette Island (19); Glacier Bay (84); Sitka (117); Yakutat Bay (244).

Several specimens of *Polysiphonia* are undeterminable and for the present can be noted only by numbers as follows; 25, 64, 123, 150, 154, 212, 363.

Family *CERAMICEÆ*.***Calithamnion floccosum pacificum* Harv.**

On *Nereocystis priapus* and other algæ, and on rocks. Puget Sound; Lowe Inlet (15); Yakutat Bay (210, 244, 199).

The most abundant species of *Calithamnion* on the Northwest coast.

***Calithamnion plumula* Lyngb.**

This species was collected several times in Puget Sound but was not seen in Alaska waters. It is a comparatively common plant in Puget Sound, while on the central California coast it is very rarely found.

***Ceratothamnion pekeanum* (Harv.) J. Ag.**

On rocks in exposed localities in the littoral and upper sublittoral zones. Sitka (152); Yakutat Bay (211); Shumagin Islands (373).

The northern plant is smaller and with shorter branches than the same species from the California coast.

***Ptilota asplenoides* Ag.**

Abundant on rocks in the sublittoral zone. Yakutat Bay (198, 219); Prince William Sound (269).

***Ptilota plumosa* Ag.**

Attached to rocks and large algæ in the sublittoral zone. Sitka (140); Shumagin Islands (397).

A much finer and more delicately branched plant than the last, with opposite similar branches.

***Ptilota serrata* Kuetz.**

In the sublittoral zone. Shumagin Islands (355).

***Antithamnion boreale* (Gobi) Kjellm.**

Occasional in the sublittoral region. Wrangell (55); Sitka (135).

In its general appearance the plant agrees with *A. boreale corallina* but the branches near the apex are not elongated as in that form.

***Ceramium rubrum* Ag.**

In the sublittoral zone. Sitka (127); Prince William Sound (275).

The Prince William Sound material, collected in June, bears an abundance of mature carpospores.

***Ceramium codicola* J. Ag.**

Attached to *Codium mucronatum californicum*, Sitka (170).

The plants are small and sterile, but agree with specimens of *C. codicola* collected by the writer on the California coast, and with specimens distributed in the *Phycotheca Boreali-Americana*.

Microcladia borealis Rupr.

In the littoral zone, attached to rocks in exposed places, Puget Sound (4).

The plant was not collected in Alaskan waters.

Rhodochorton rothii (Turton) Naegeli.

Forming a dense coating on rocks, especially in caverns in the upper sublittoral or littoral zones, Prince William Sound (292).

The writer has collected this plant also on the central California coast and in Puget Sound.

Family *GLOIOSIPHONIACEÆ*.**Gloiopeltis furcata** (P. & R.) J. Ag.

Attached to rocks in the sublittoral zone from Puget Sound to the Shumagin Islands. Annette Island (26); Sitka (124); Yakutat Bay (201); Shumagin Islands (372).

Not common at any of the stations.

Gloiosiphonia californica (Farl.) J. Ag.

In the sublittoral region in a protected cove, Prince William Sound (277).

This species was originally described by Dr. Farlow from the central California coast. He placed it somewhat questionably in the genus *Nemastoma* on account of having only dry material for examination. J. Agardh, in Till Algernes Systematik, transferred the species to *Gloiosiphonia*. Dr. Farlow recently stated that since the publication of the species he had examined both living and alcoholic material and believed that Agardh was right in placing it in *Gloiosiphonia*.

Family *GRATLOUPIACEÆ*.**Cryptonemia obovata**? J. Ag.

Washed ashore, Prince William Sound (276).

Two sterile specimens of a *Cryptonemia* are referred somewhat questionably to this species. They agree in shape and structure with fruiting specimens collected in Puget Sound which undoubtedly belong to this species.

Family *DUMONTIACEÆ*.**Dumontia filiformis** (Lyngb.) Ag.

Abundant in the sublittoral zone in protected places from Prince William Sound northward and westward. Prince William Sound (307, 280); Cook Inlet (411); Kukak Bay (340); Shumagin Islands (365).

The specimens from Cook Inlet bear an abundance of cystocarps; the others have tetraspores.

Cryptosiphonia grayana J. Ag.

In the sublittoral zone. Wrangell (162); Sitka (132); Yakutat Bay (208); Kukak Bay (330).

The Yakutat and Kukak Bay specimens bear cystocarps, the Sitka and Wrangell material tetraspores.

Dilsea californica (J. Ag.) Schmitz.

In the sublittoral zone, Orca, Prince William Sound (313).

The large sterile plants (3-5 dm. long by 1-2 dm. broad) were submitted to Dr. Setchell and were referred by him to this species.

Dilsea arctica (Kjellm.)

Attached to rocks in the sublittoral zone, Shumagin Islands (353).

Young plants are broadly ovate or reniform, and of a light rose-red color, older specimens are once to twice longitudinally divided nearly to the base and of a light faded red color.

Constantinea rosa-marina (Gmel.) J. Ag.

In the upper part of the elittoral zone, Prince William Sound (298).

It was observed at several other stations, including the Shumagin Islands, but no collections were made. It occurs in both protected and exposed situations, but seems to be more abundant in exposed localities. Its occurrence in Puget Sound would indicate a general distribution from that locality to Bering Sea.

Family *SQUAMARIACEÆ*.

Hildenbrandtia rosea Kuetz.

Forming a very delicate rose-red crust on rocks in the littoral and sublittoral zones, from Puget Sound to the Shumagin Islands.

The same species is reported by Kjellman from Bering Sea. The writer has also found it common on the central California coast. All specimens were sterile.

Family *CORALLINACEÆ*.¹

Melobesia patens.

On *Amphiroa epiphlegmoides*, Prince William Sound (423a).

Dr. Foslie is somewhat in doubt as to the species, labeling specimens submitted to him, "*M. patens* or n. sp."

¹ Specimens of all Corallinaceæ enumerated were sent to Dr. Kjellman who requested Dr. Foslie to work them over. The determinations are entirely those of Dr. Foslie.

Lithophyllum farlowii Foslie.

On rocks in the littoral zone, Sitka (138).

The young plants were somewhat doubtfully referred to the species by Dr. Foslie.

Lithothamnion compactum Kjellm.

Forming an indefinite coating on rocks in the sublittoral zone, Prince William Sound (431).

Lithothamnion glaciale Kjellm.

In the upper elittoral and lower sublittoral zones. Prince William Sound (430); Kukak Bay (427); Shumagin Islands (426). Abundant in exposed localities.

Lithothamnion læve (Stroemf.) Foslie.

Abundant on rocks in exposed localities in the sublittoral zone, Kukak Bay (425a), with *Clathromorphum circumscriptum*.

Clathromorphum circumscriptum (Stroemf.) Foslie.

On rocks in the sublittoral and elittoral zones. Kukak Bay (425); Sitka (441).

Lepidomorphum yendori Foslie.

On rocks in the sublittoral zone, Sitka (438).

Amphiroa tuberculosa Rupr.

On rocks in the lower sublittoral zone, Sitka (432).

Amphiroa epiphlegmoides J. Ag.

On rocks and other algæ. Sitka (433); Prince William Sound (423).

Amphiroa planiuscula (Kuetz.) Foslie.

- On mussel shells, rocks, etc., in the lower sublittoral zone. Yakutat Bay (255); Prince William Sound (429).

Corallina arbuscula Rupr.

On rocks in the sublittoral zone. Shumagin Islands (438).

Corallina pilulifera filiformis Rupr.

On rocks in the sublittoral zone. Prince William Sound (435).

BACILLARIACEÆ.¹**Melosira granulata** C. G. E.

In a freshwater pond, Popof Island, near Kukak Bay; Kadiak Island; Cook Inlet.

¹ Determined by Prof. A. M. Edwards.

Melosira nummuloides B. de st. V.

In salt water near Juneau; Glacier Bay.

Melosira sol C. G. E.

Attached to seaweeds from Annette Island.

Melosira sulcata C. G. E.

Attached to seaweeds from Annette Island.

Trochiscia moniliformis F. C. M.

Attached to seaweeds from Annette Island; Glacier Bay.

Coscinodiscus argus C. G. E.

In salt water material from Annette Island; Yakutat Bay.

Coscinodiscus lineatus C. G. E.

In salt water from Glacier Bay.

Thalassosira cleve H. H. G.

In salt water from Glacier Bay.

Triceratium wilkesii J. W. B.

In salt water near Wrangell.

Chætoceros hispidum C. G. E.

One specimen was found in material from Annette Island.

Biddulphia aurita L. W. D.

Attached to seaweeds from Annette Island; Popoff Island.

Isthmia obliquata J. E. S.

In salt water from Yakutat Bay; Victoria, British Columbia.

Rhabdonema biquadratum J. B.

Material from Annette Island.

Rhabdonema fauriae P. P.

Material from Annette Island.

Rhabdonema japonica T. & B.

Material from Annette Island.

Rhabdonema elegans J. B.

Material from Annette Island.

Rhabdonema striatulum J. E. S.

In salt water material from Annette Island; Glacier Bay; Popoff Island; Yakutat Bay.

Rhabdonema arcuata F. T. K.

In salt water, Yakutat Bay.

Tabellaria flocculosa F. T. K.

In a freshwater pond, Popof Island; Kadiak Island; Kukak Bay.

Grammatophora marina (Lyngb.) Kuetz.

In salt water from Yakutat Bay.

Licmophora granulata V.

In salt water from Glacier Bay.

Licmophora cuneata F. C. L.

Attached to seaweeds, Glacier Bay.

Licmophora pennatula V.

In salt water near Juneau; Annette Island; Yakutat Bay; Wrangell; Popof Island.

Meridion circulare C. A. A.

In a freshwater pond, Popof Island.

Diatoma hyemale H. C. L.

In a freshwater pond, Popof Island.

Diatoma pectinale O. F. M.

In a freshwater pond, Popof Island.

Fragilaria construens C. G. E.

In a freshwater pond, Popof Island.

Fragilaria virescens J. R.

In a freshwater pond, Popof Island.

Fragilaria striatula H. C. L.

In material from salt water. Sitka; near Juneau; Popof Island.

Fragilaria exilis A. G.

In salt water, Yakutat Bay.

Synedra crotonensis A. M. E.

In a freshwater pond, Popof Island; Cook Inlet.

Synedra ulna C. L. N.

In a freshwater pond, Popof Island; Kadiak Island.

Synedra prolongata A. S.

In a fresh water pond, Cook Inlet.

Synedra fasciculata C. A. A.

Attached to seaweeds from Annette Island; Glacier Bay; Yakutat Bay.

Eunotia robusta J. R.

In a freshwater pond, Kadiak Island; Cook Inlet; Kukak Bay.

Eunotia gracilis C. G. E.

In a freshwater pond, Popof Island.

Eunotia lunaris C. G. E.

In a freshwater pond, Popof Island; Kadiak Island.

Cocconeis placentula C. G. E.

In a freshwater pond, Kadiak Island.

Cocconeis scutellum C. G. E.

In salt water from Victoria, British Columbia; attached to seaweeds from Annette Island; freshwater pond, Kadiak; salt water, Yakutat Bay; Juneau; Popof Island.

Achnanthes subsessilis C. G. E.

In salt water from Glacier Bay.

Achnanthes lanceolata A. B.

In a freshwater pond, Popof Island; near Kukak Bay.

Achnanthes glabrata A. G.

In salt water, Yakutat Bay.

Cocconema lanceolatum C. G. E.

Material from salt water, Annette Island; in a freshwater pond, Popof Island; Kadiak Island; Cook Inlet.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Navicula silicula C. G. E.

In a freshwater pond, Popof Island.

Navicula cyprinus C. G. E.

In a freshwater pond, Popof Island.

Navicula elliptica F. T. K.

In a freshwater pond, Popof Island; attached to seaweeds from Popof Island.

Navicula major F. T. K.

In a freshwater pond, Popof Island; Annette Island; Kukak Bay.

Navicula radiosa F. T. K.

In a freshwater pond, Popof Island.

Navicula legumen C. G. E.

In salt water material from Annette Island.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Navicula pupula C. A. A.

In salt water material from Annette Island.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Navicula apis C. G. E.

Material from Annette Island; Popof Island.

Vanheurckia rhomboides A. B.

In a freshwater pond near Kukak Bay.

Pleurosigma angulata W. S.

In salt water, Yakutat Bay.

Pleurosigma attenuata F. T. K.

In a freshwater pond, Kadiak Island.

Pleurosigma fasciola C. G. E.

In salt water near Wrangell.

Nitzschia diadema F. T. K.

In salt water, Yakutat Bay.

Nitzschia angularis W. S.

In salt water, Yakutat Bay.

Nitzschia closterium C. G. E.

In salt water material, Annette Island.

Nitzschia sigmoidea C. L. N.

In salt water material from Annette Island.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Nitzschia vermicularis F. T. K.

In a freshwater pond, Popof Island.

Surirella elegans C. G. E.

In a freshwater pond, Popof Island.

Staureoneis phœnicenteron C. L. N.

Material from Annette Island; freshwater pond, Kadiak Island; Kukak Bay.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Amphora ovalis C. G. E.

In salt water from Glacier Bay.

Amphora elliptica C. A. A.

In salt water, Yakutat Bay.

Gomphonema geminatum C. G. E.

In a freshwater pond, Kadiak Island.

Gomphonema affine F. T. K.

In a freshwater pond, Kadiak Island.

Gomphonema subtile C. G. E.

In a freshwater pond, Popof Island.

Rhoicosphenia curvata F. T. K.

In salt water material from Annette Island; Yakutat Bay; Popof Island.

Cymbella inæqualis C. G. E.

From salt water material from Annette Island.

A freshwater species, the dead shells of which had been carried into the ocean by streams or glaciers.

Cymbella ehrenbergii F. T. K.

In a freshwater pond, Popof Island; Kadiak Island.

Epithemia gibba C. G. E.

In a freshwater pond, Popof Island; Kadiak Island.

Epithemia jurgensii C. A. A.

In a freshwater pond, Popof Island; Cook Inlet; Annette Island.

Epithemia westermanni C. G. E.

In a freshwater pond, Popof Island.

PLATE XLIII.¹

- FIG. 1. *Cosmarium conspersum* Ralfs.
 2. " *calatum* Ralfs.
 3. " *ornatum* Ralfs.
 4. *Euastrum crassum* (Bréb.) Kuetz.
 5. *Cosmarium pseudotaxichondrum* Nordst.
 6. " *parvulum* Bréb.
 7. " *hammeri* Reinsch.
 8. " *granatum* Bréb.
 9. *Euastrum verrucosum* Ehrenb.
 10. *Cosmarium ochtodes* Nordst.
 11. " *botrytis* Menegh.
 12. " *portianum nephroideum* Wittr. Front view.
 13. " " " " End view.
 14. *Closterium parvulum* Naeg.
 15. " *venus* Kuetz.
 16. *Staurastrum echinatum* Pecten (Perty) Rab.
 17. *Cosmarium depressum* (Naeg.) Lund.
 18. " *pulcherrimum* Nordst.
 19. " " " From Kukak Bay.
 20. " *subcrenatum* Hantzsch.
 21. " *pseudogranatum* Nordst.
 22. " *quadrifarium* Lund.
 23. *Staurastrum polymorphum* Bréb. End view.
 24. " " " Front view.
 25. *Microsterias rotata* (Grev.) Ralfs.
 26. *Cosmarium broomei* Var. Thwaites.
 27. *Closterium accrosus* (Schrank), Ehrenb.
 28. *Cosmarium bioculatum* Bréb.
 29. *Mesotanium braunii* De Bary.
 30. *Disphinctium connatum* (Bréb.) De Bary.
 31. *Staurastrum calyxoides* Wolle.
 32. *Euastrum affine* Ralfs.
 33. *Cosmarium constrictum* Delp. Side view.
 34. " " " Front view.
 35. " *broomei* Thwaites. End view.
 36. " " " Front view.
 37. *Euastrum oblongum* (Grev.) Ralfs.
 38. *Xanthidium antilopæum* (Bréb.) Kuetz.
 39. *Cosmarium sexangulare* Lund.
 40. " *pyramidatum* Bréb.

¹ Plates xliii-lxii are from drawings by Eva M. Saunders, except for plates xlv, figs. 1 and 2, which were drawn by Edna L. Hyatt.

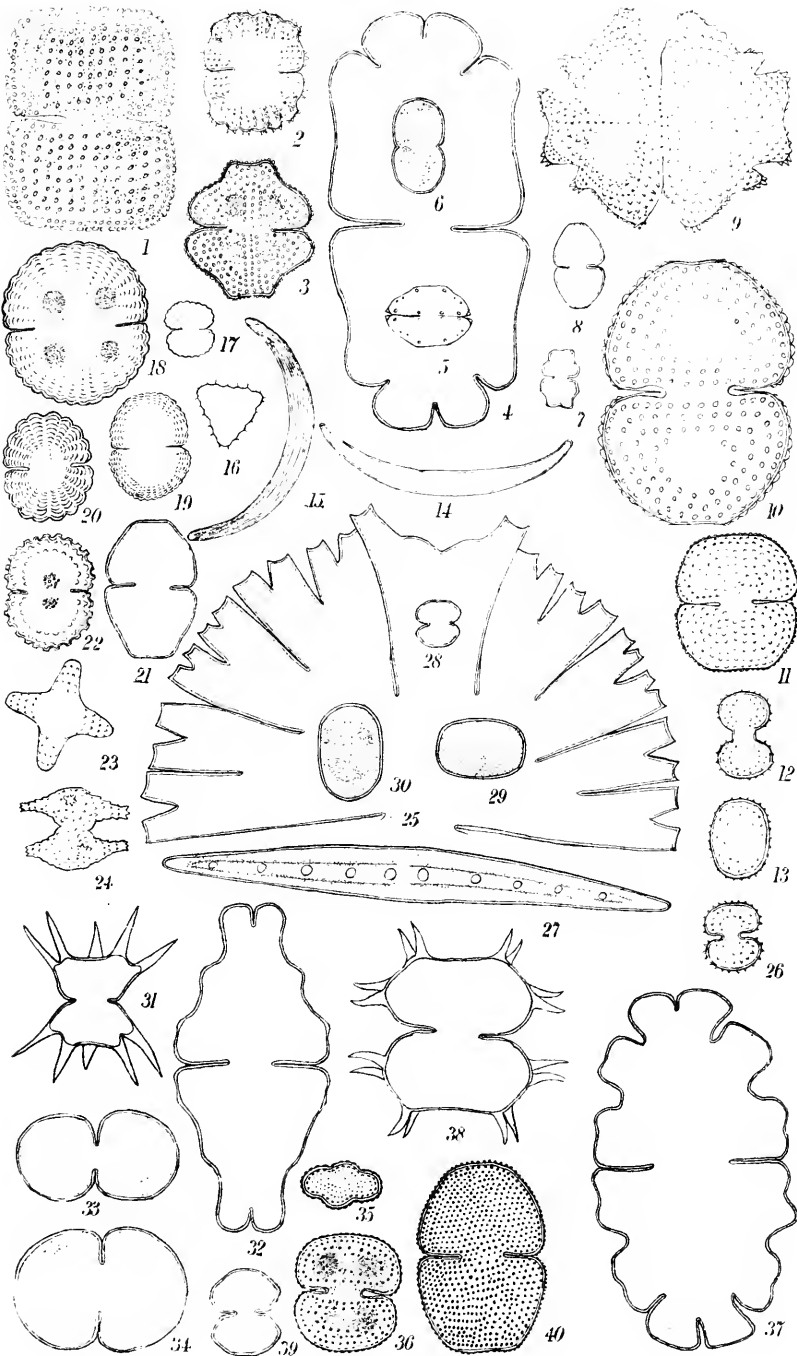


PLATE XLIV.

- FIG. 1. *Cosmarium intermedium* Delp.
 2. *Euastrum elegans* (Bréb.) Kuetz.
 3. *Penium digitus* (Ehrenb.) Bréb.
 4. *Cosmarium latum* Bréb.
 5. *Staurostrum dejectum* Bréb. *a*, *b* and *c*.
 6. *Cosmarium sphaerostichum* Nordst.
 7. *Micrasterias truncata* (Corda) Ralfs.
 8. *Cosmarium phaseolus* Bréb.
 9. *Cosmarium undulatum* Corda.
 11. *Micrasterias denticulata* (Bréb.) Ralfs.
 12. *Cosmarium pachydermum* Lund.
 13. *Tetmemorus brebissonii* (Menegh.) Ralfs.
 14. *Arthrodesmus convergens* Ehrenb.
 15. *Cosmarium blyttii* Wille.
 16. *Cosmarium contractum* Kirch.
 17. " *kitchelii* Wolle.
 18. *Xanthidium armatum* (Bréb.) Ralfs.
 19. *Cosmarium meneghinii braunii* (Reinsch.) Hansg.
 20. *Pleurotigniopsis debaryi* (Archer) Lund.
 21. *Cosmarium tumidum* Lund.
 22. " *ralfsii* Bréb.
 23. *Micrasterias kitchelii* Wolle.
 24. *Euastrum didelta* (Turp.) Ralfs.
 25. " *elegans* (Bréb.) Kuetz.
 26. " " " Two forms.
 27. *Micrasterias oscitans pinnatifida* (Kuetz.) Rabenh.
 28. *Cosmarium holmiense* Lund.
 29. *Staurostrum ravenelii* Wood. *a*, front view: *b*, end view.
 30. *Euastrum elegans*, large form.
 31. *Micrasterias fimbriata elephantia* Wolle.

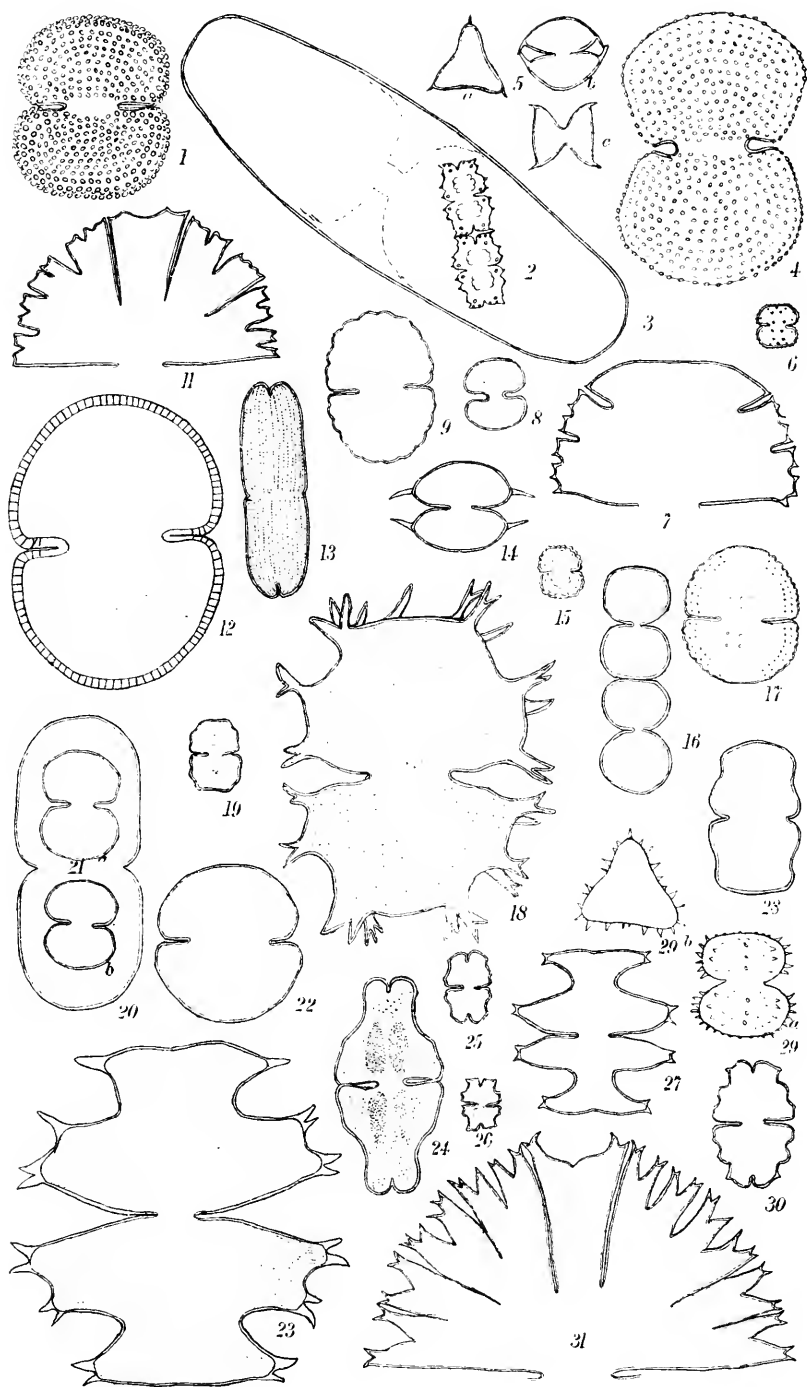


PLATE XLV.

- FIG. 1. *a* and *b*. *Streblonema pacifica* sp. nov.
2. *Streblonema irregularis* sp. nov.
3. “ *minutissima* sp. nov.

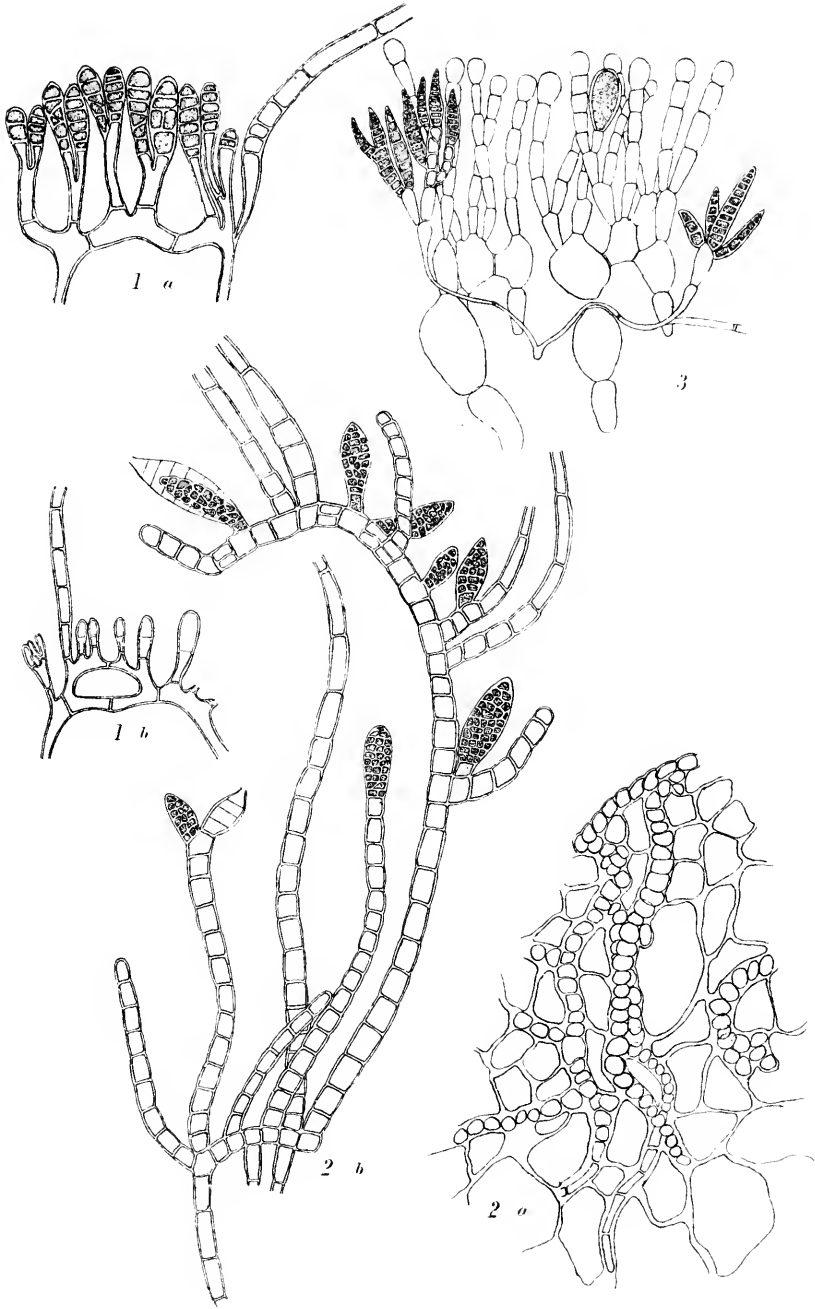


PLATE XLVI.

- FIG. 1. *Myrionema strangulans* Grev.; tufts natural size.
 2. " " " section ($\times 400$).
 3. *Homcostroma undulatum* J. Ag.
 4. *Dermocarpa fucicola* sp. nov.; section ($\times 400$).
 5. " " " natural size.
 6a. *Homcostroma lobatum* sp. nov.; natural size.
 6b. " " " portion of edge ($\times 30$).
 6c. " " " section ($\times 400$).

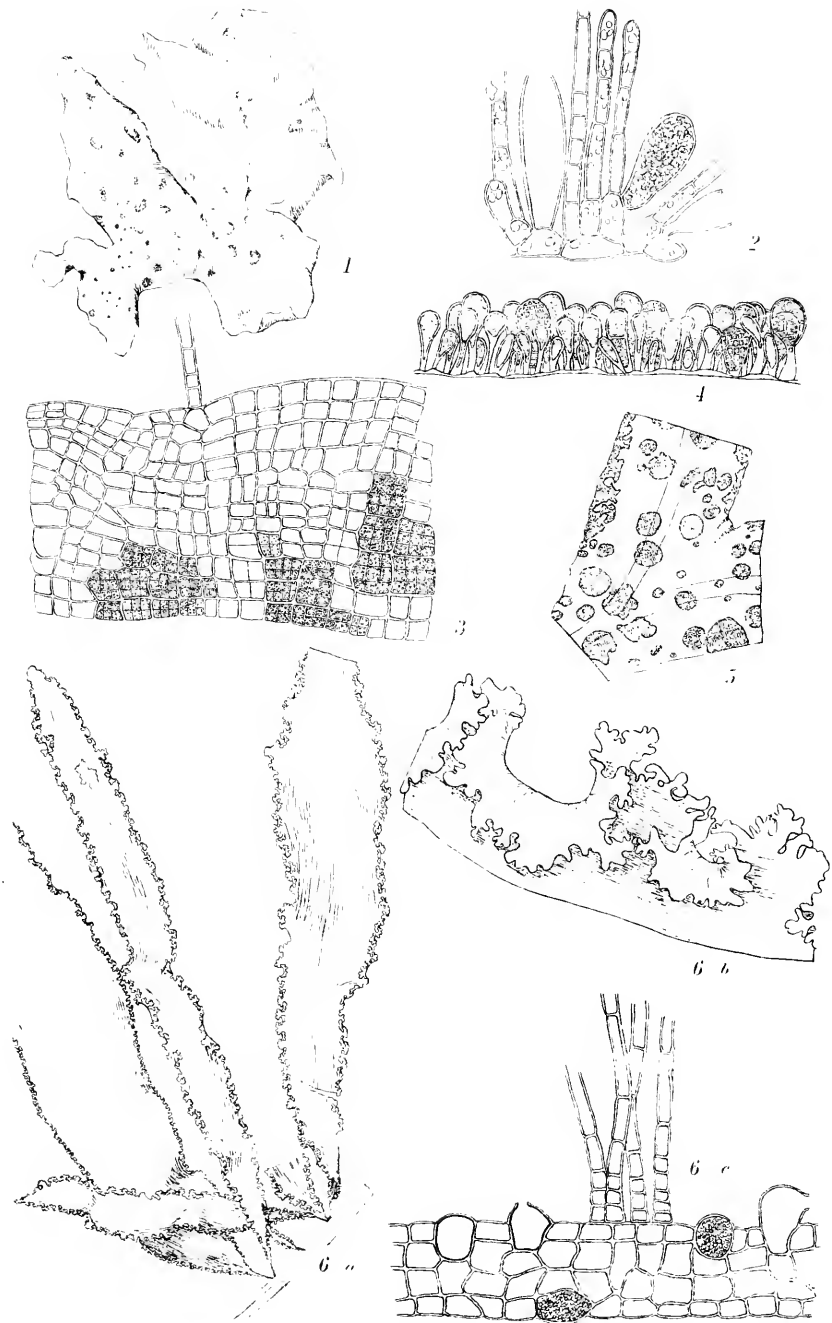


PLATE XLVII.

FIG. 1. *Myelophycus intestinalis* sp. nov.: natural size.

2. " " " cross section ($\times 400$).

3. " " " longitudinal section ($\times 400$).

(456)

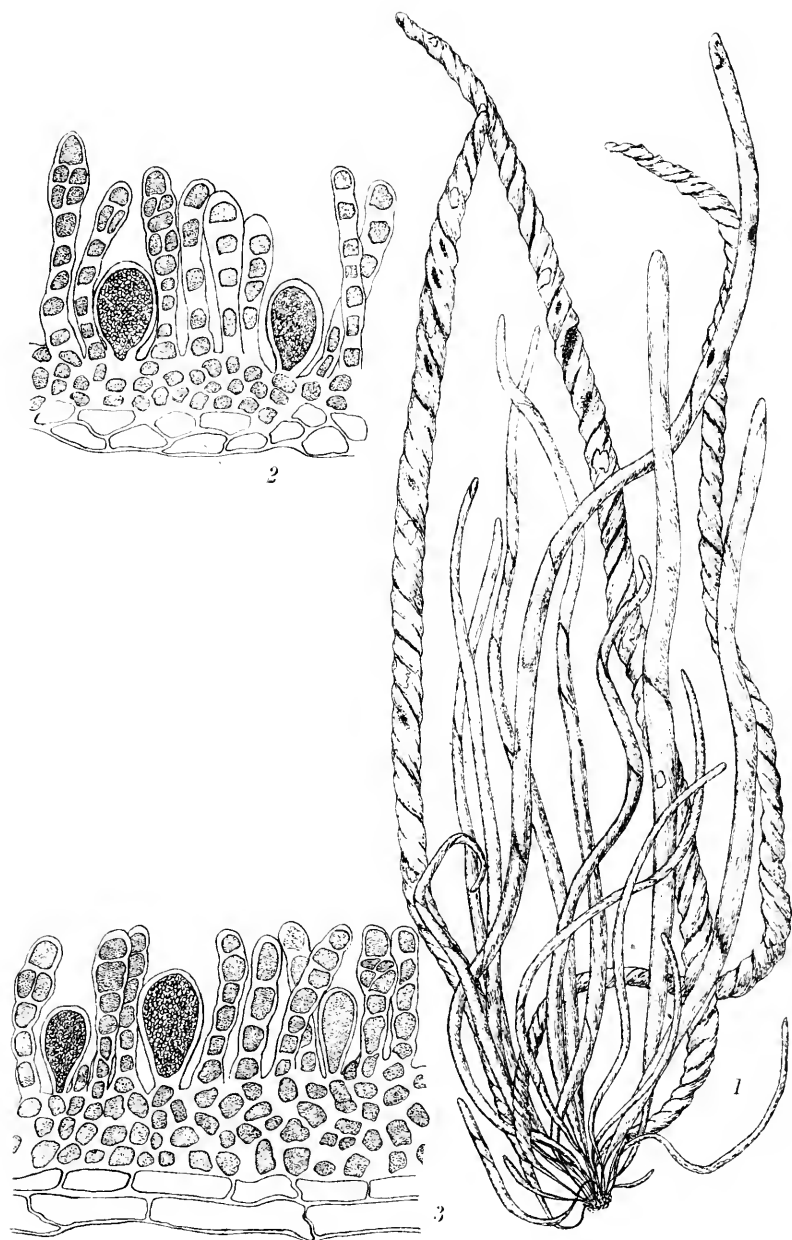


PLATE XLVIII.

FIG. 1. *Coilodesme linearis* sp. nov.: natural size.

2. " " " cross section ($\times 400$).

(458)

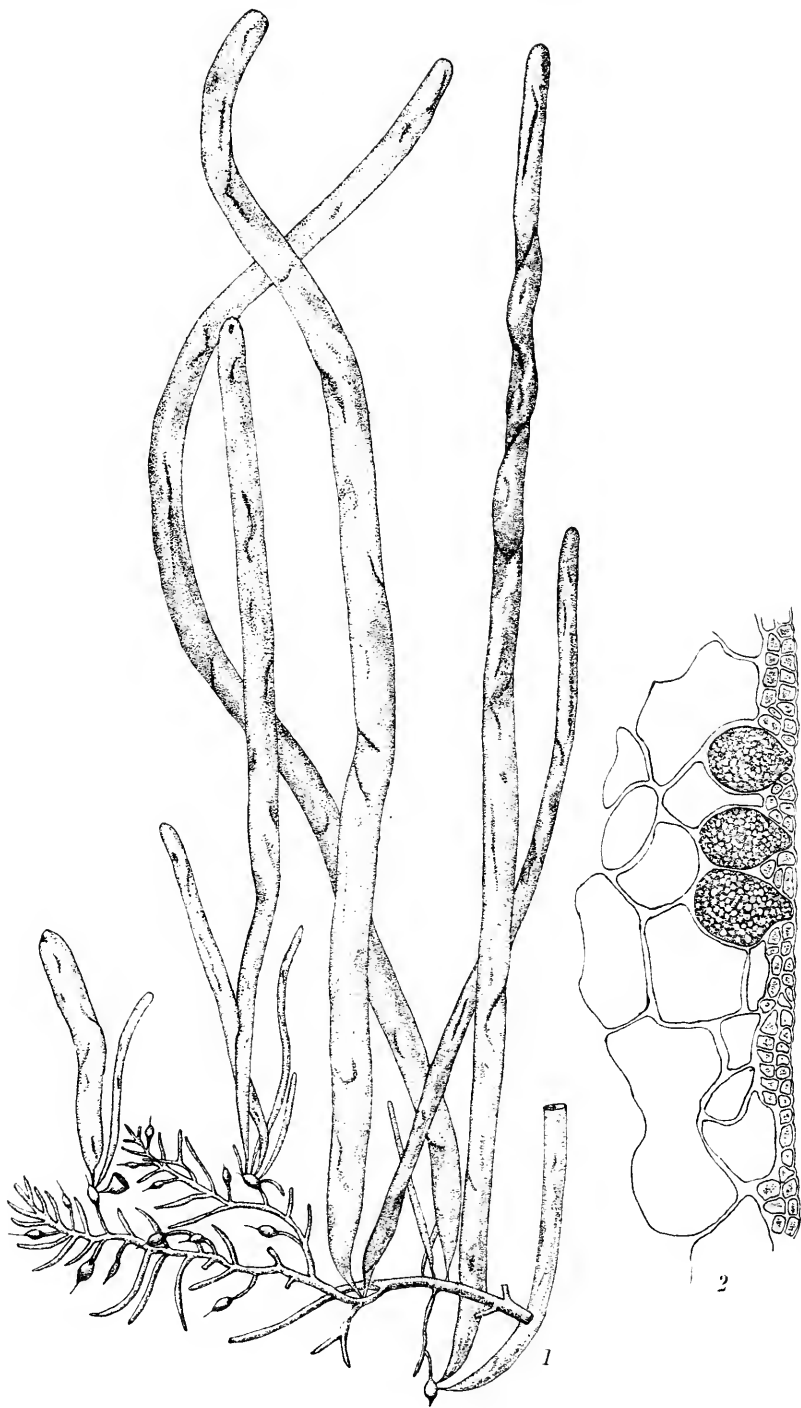


PLATE XLIX.

FIG. 1. *Liebmannia* ?; natural size.

2. “ peripheral filaments ($\times 400$).

(460)

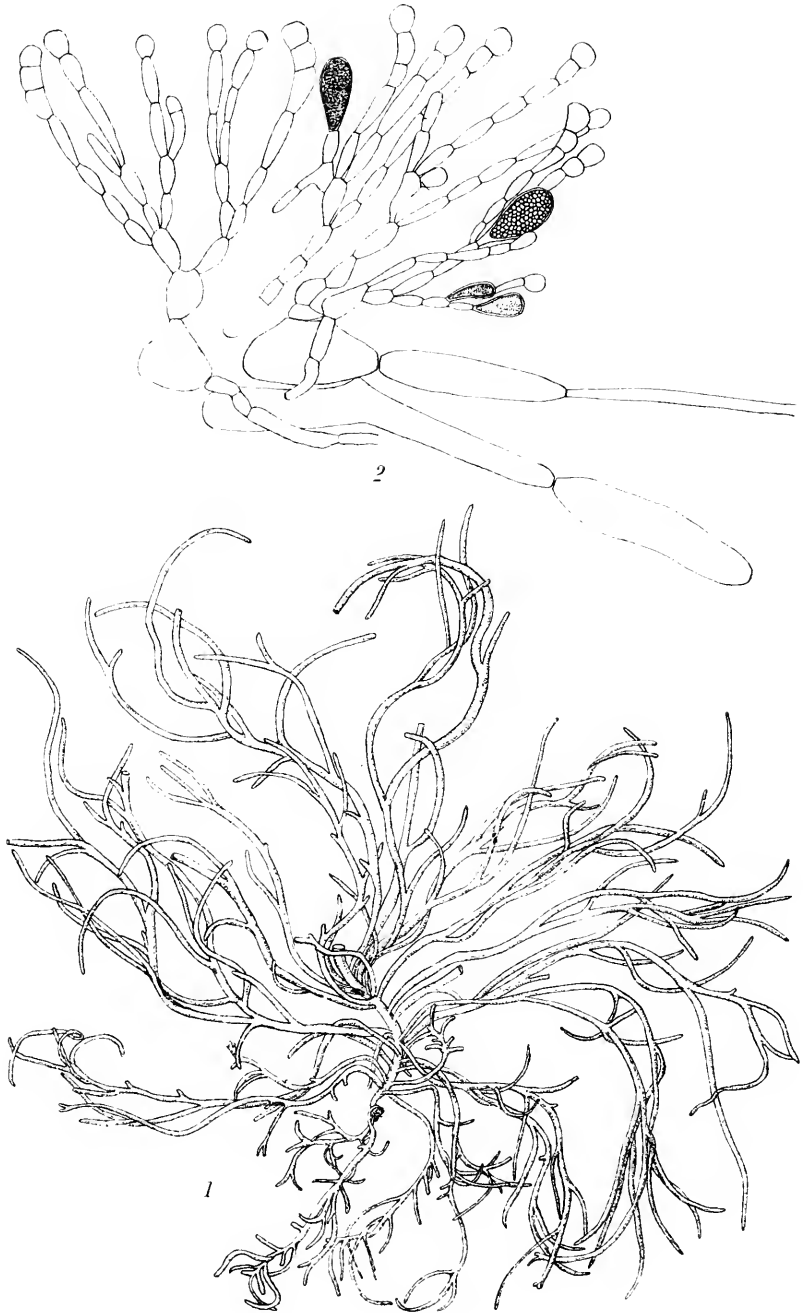


PLATE L.

- FIG. 1. *Laminaria cuneifolia* J. Ag.
2. *Mesogloia simplex* sp. nov.
3. " " section ($\times 100$).
4. " " ($\times 400$).

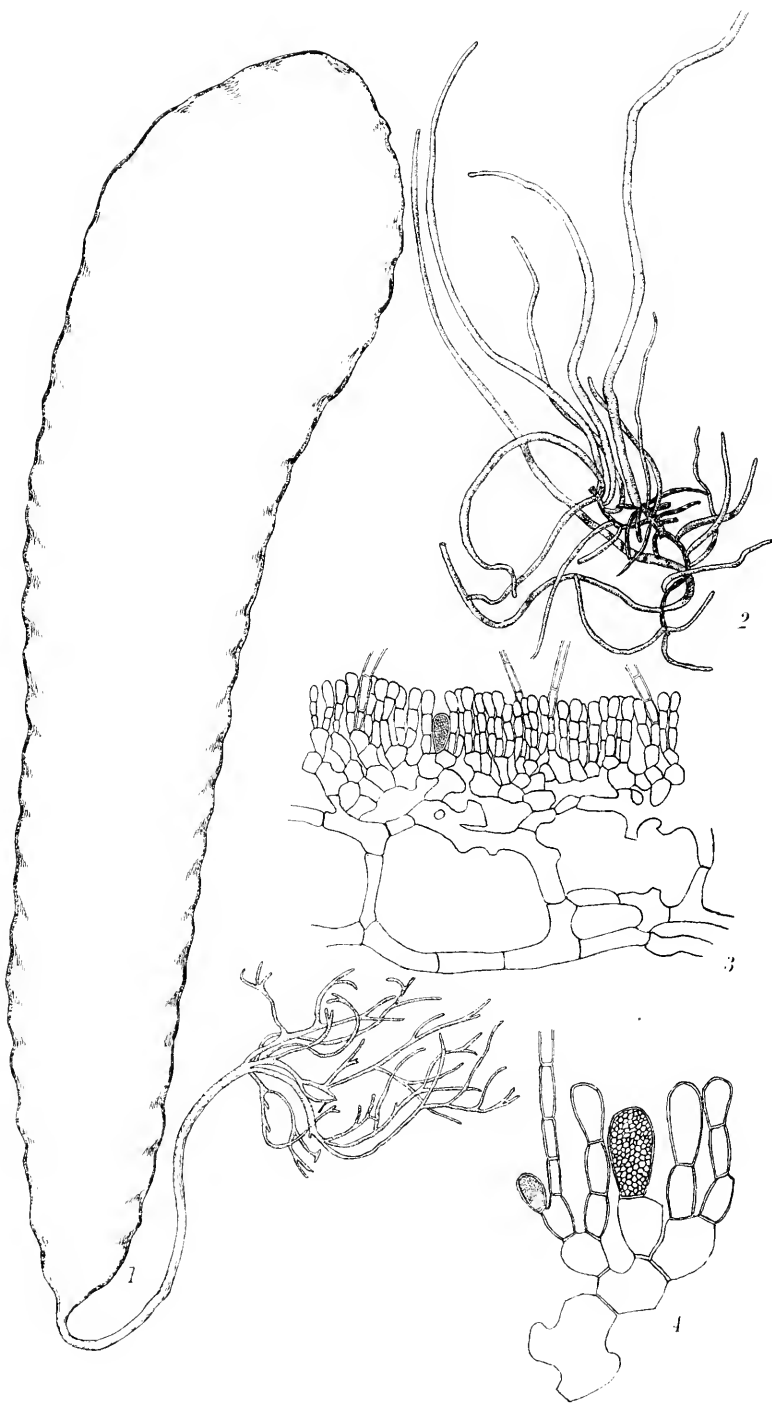
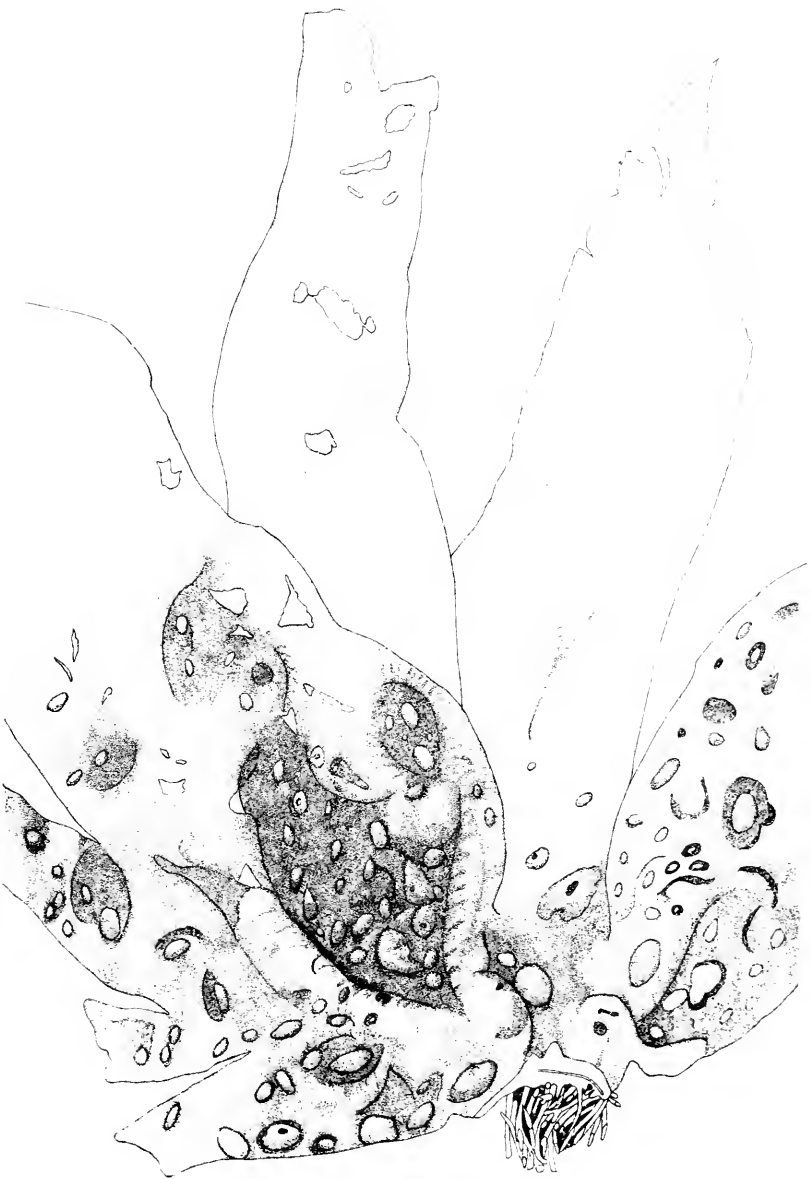




PLATE LI.

Hedophyllum sessile (Ag.) Setchell.

(464)



ALASKA ALGAE.

HELIOTYPE PRINTING CO



PLATE LII.

FIG. 1. *Pleurophyucus gardneri* gen. et sp. nov. Setchell and Saunders: $\frac{1}{4}$ natural size.

2. " " young plant.

3. " " cross section of blade ($\times 400$).

4. " " longitudinal section of blade, showing fruit.

5. " " *a*, section of stipe near the transition point natural size; *b*, section of stipe near base, natural size; *c*, portion of same ($\times 80$).

(466)

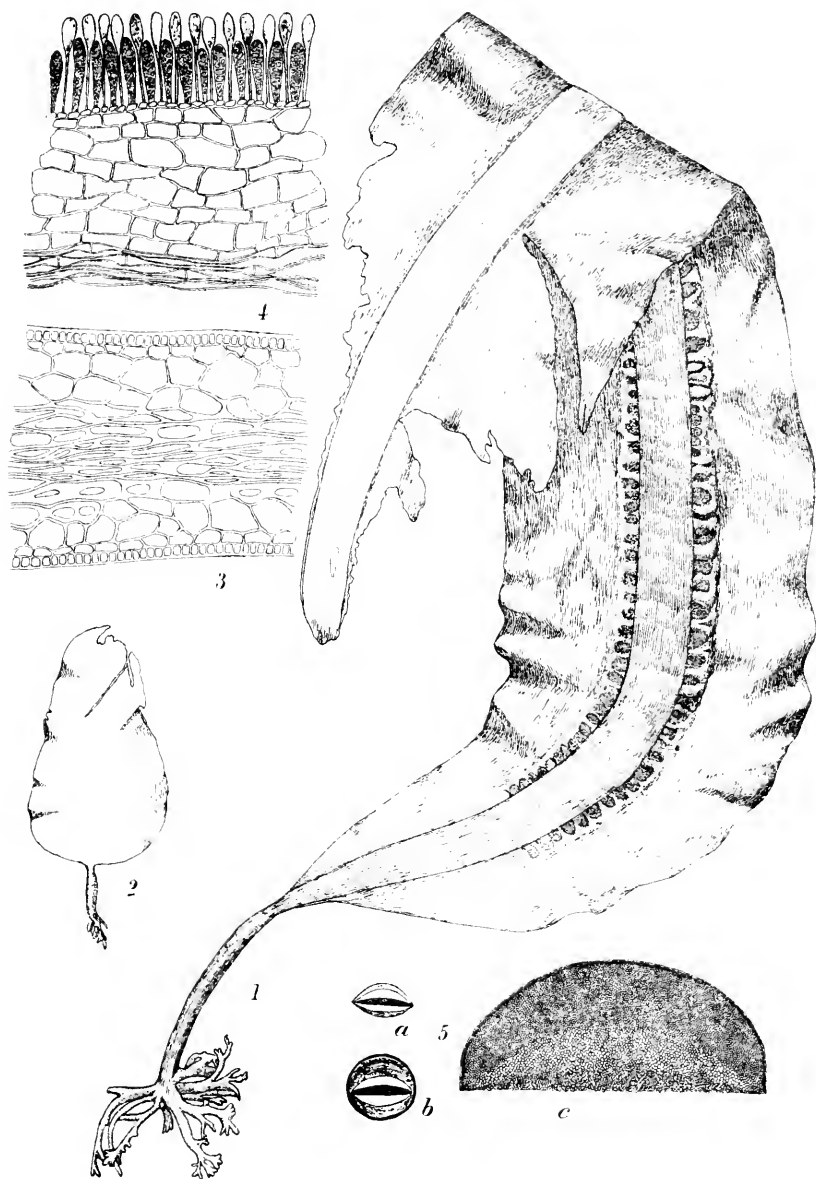
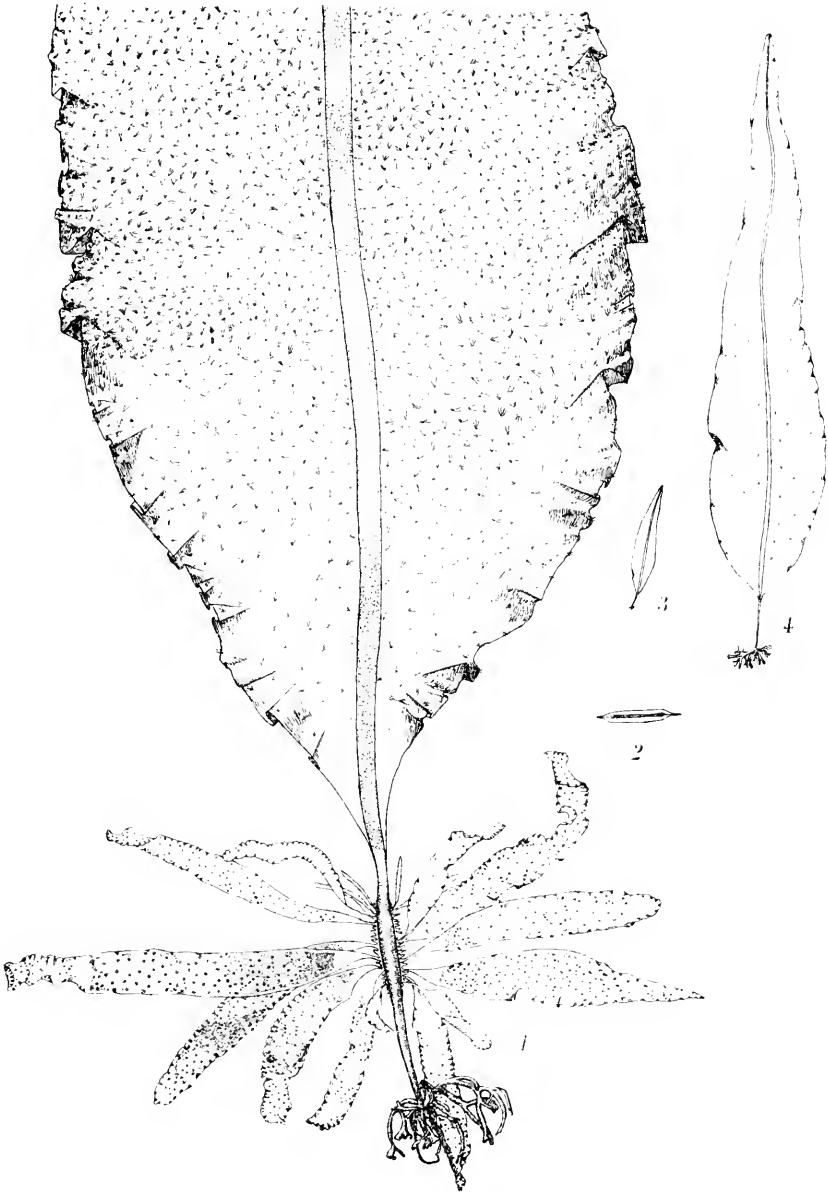


PLATE LIII.

- FIG. 1. *Alaria lanccolata*, Kjellm. : $\frac{1}{2}$ natural size.
2. " " " section of blade, natural size.
3, 4. " " " young plants.

(468)



ALASKA ALGAE.

HELIOTYPE PRINTING OF

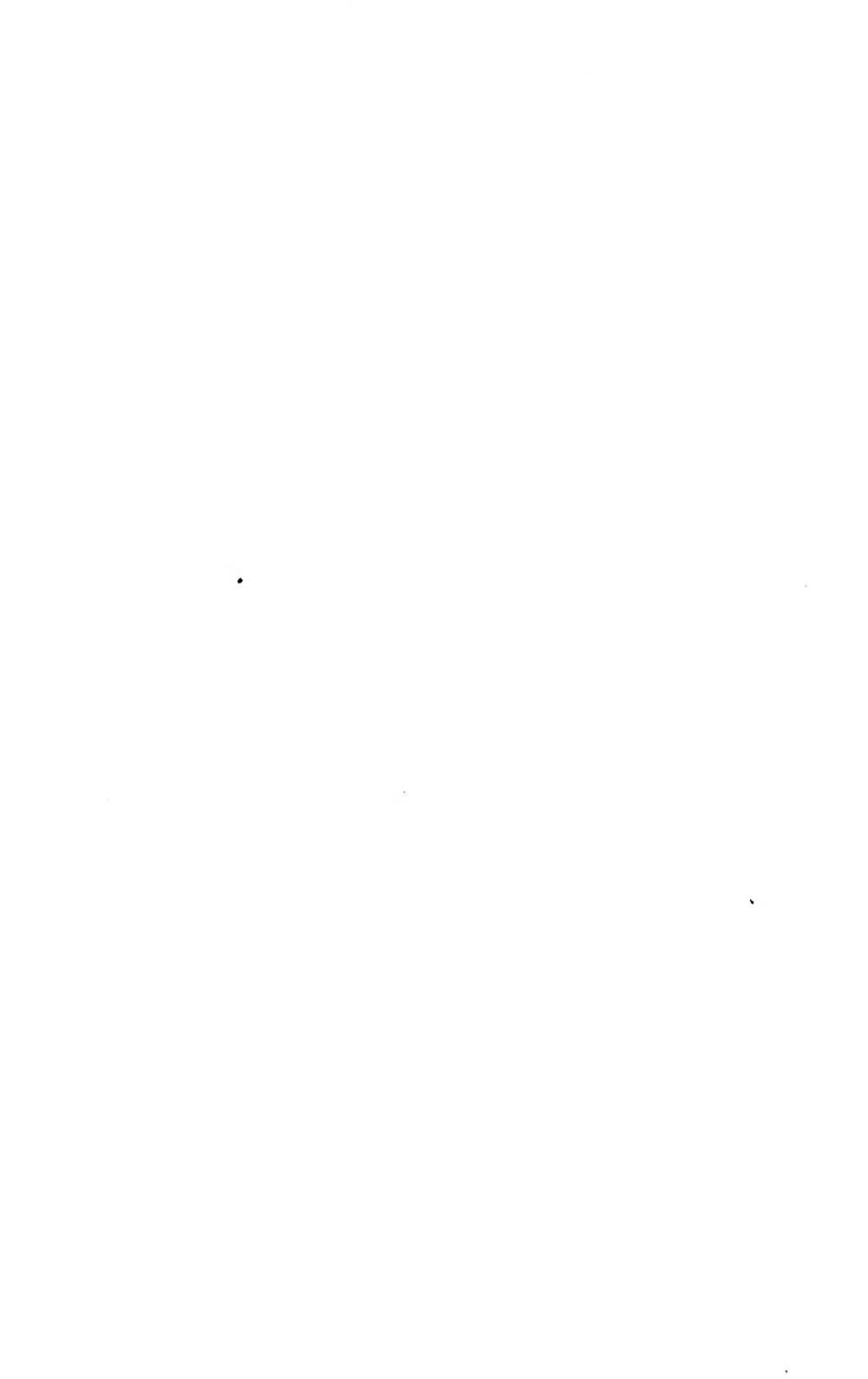


PLATE LIV.

Alaria fragilis sp. nov.

(470)

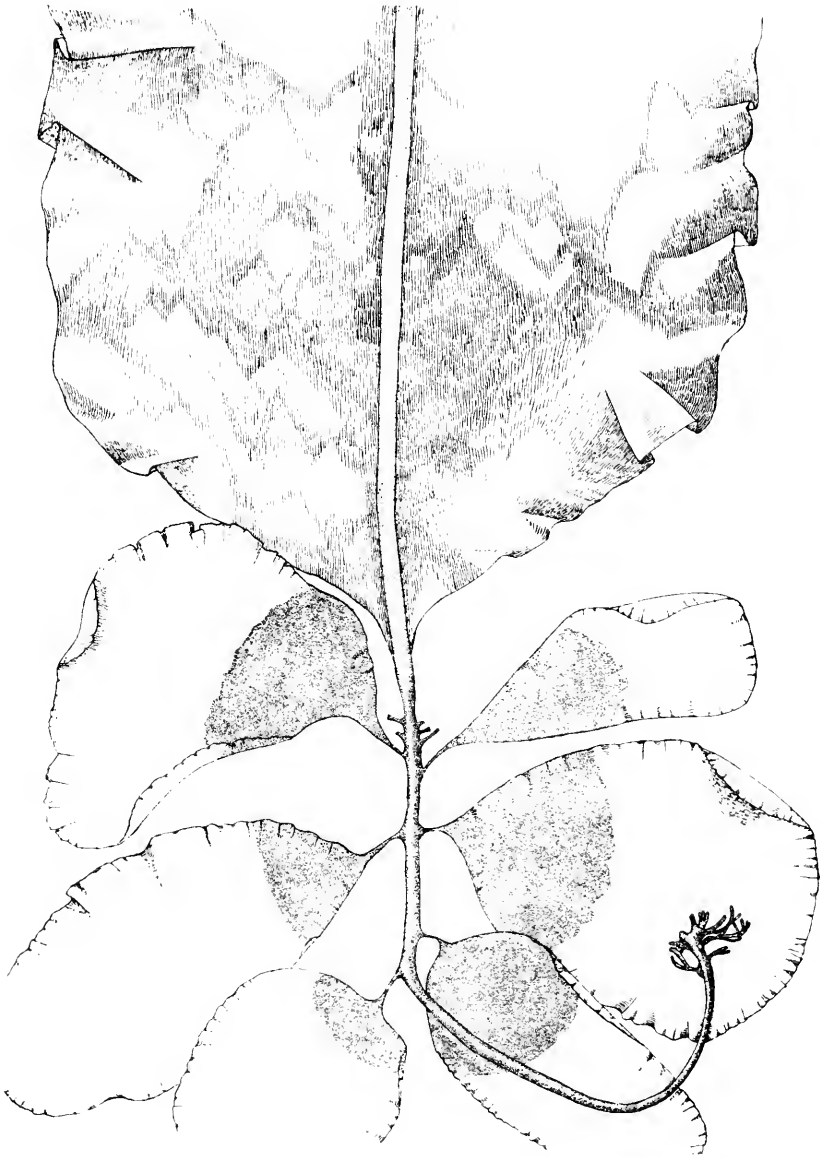


PLATE LV

Alaria laticosta Kjellman.

(472

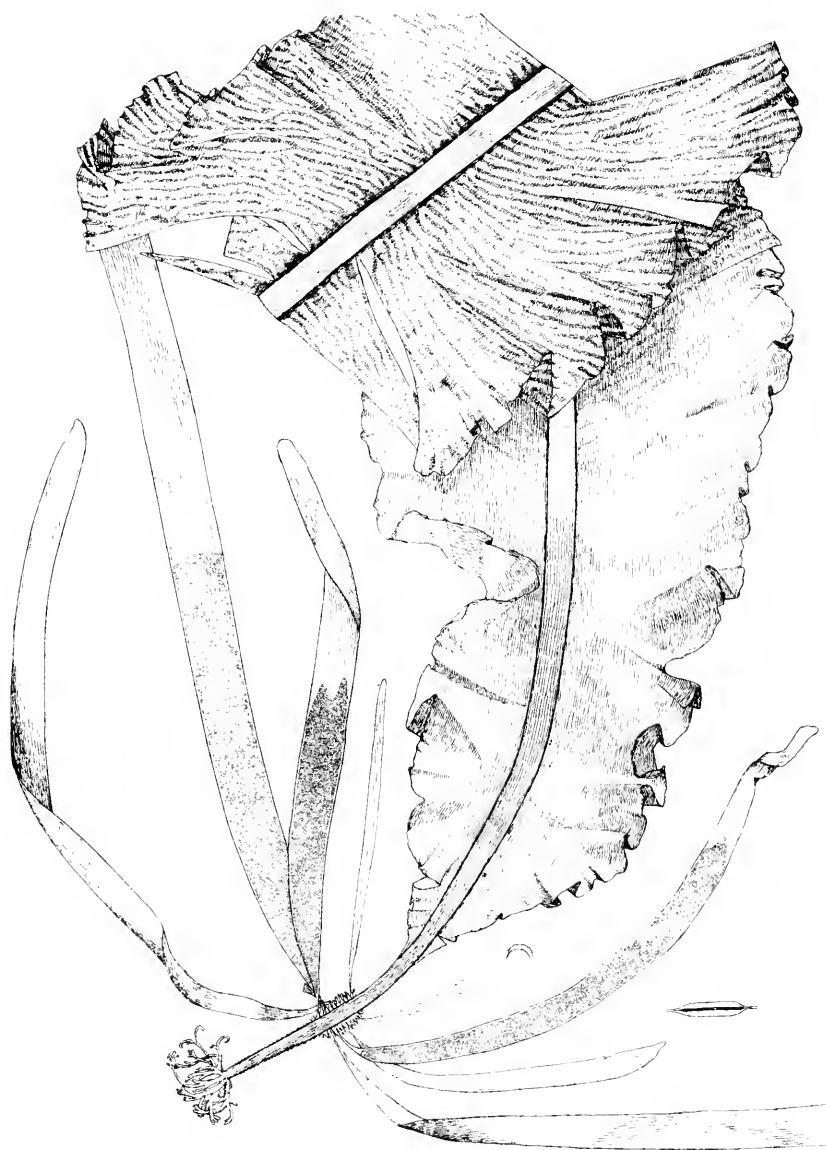


PLATE LVI.

Alaria cordata Tilden.

(474)

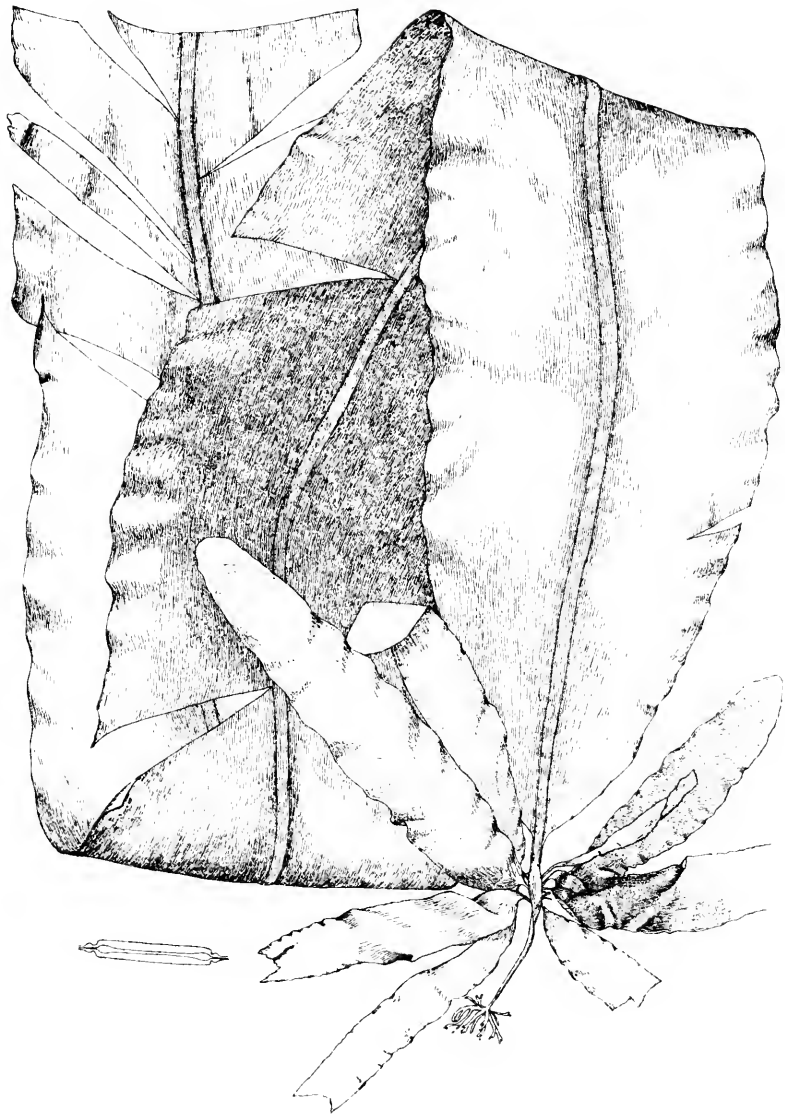


PLATE LVII.

- FIG. 1. *Alaria fistulosa* Post & Rupr. : $\frac{1}{4}$ natural size.
 2. " " " " section of midrib : natural size.
 3. 4. " " " " portions of the midrib ($\times 80$).

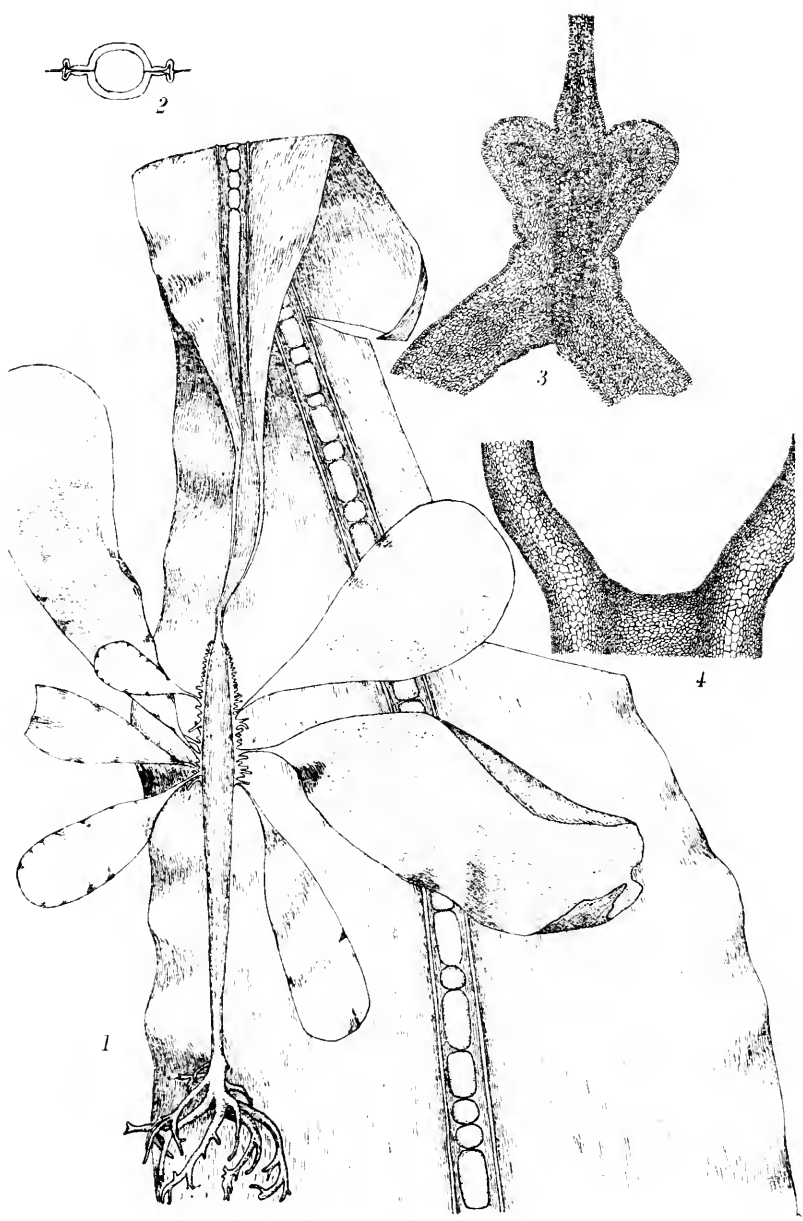


PLATE LVIII.

- FIG. 1. *Nereocystis priapus* (Gmel.) Saunders: much reduced.
 2. " " " section of blade showing fruit.
 3. " " " longitudinal section showing mucous canals
 (X 40).
 4. *Nereocystis priapus* (Gmel.) Saunders (X 40).
 5. " " " cross section of stipe showing mucous
 canals and secreting cells.

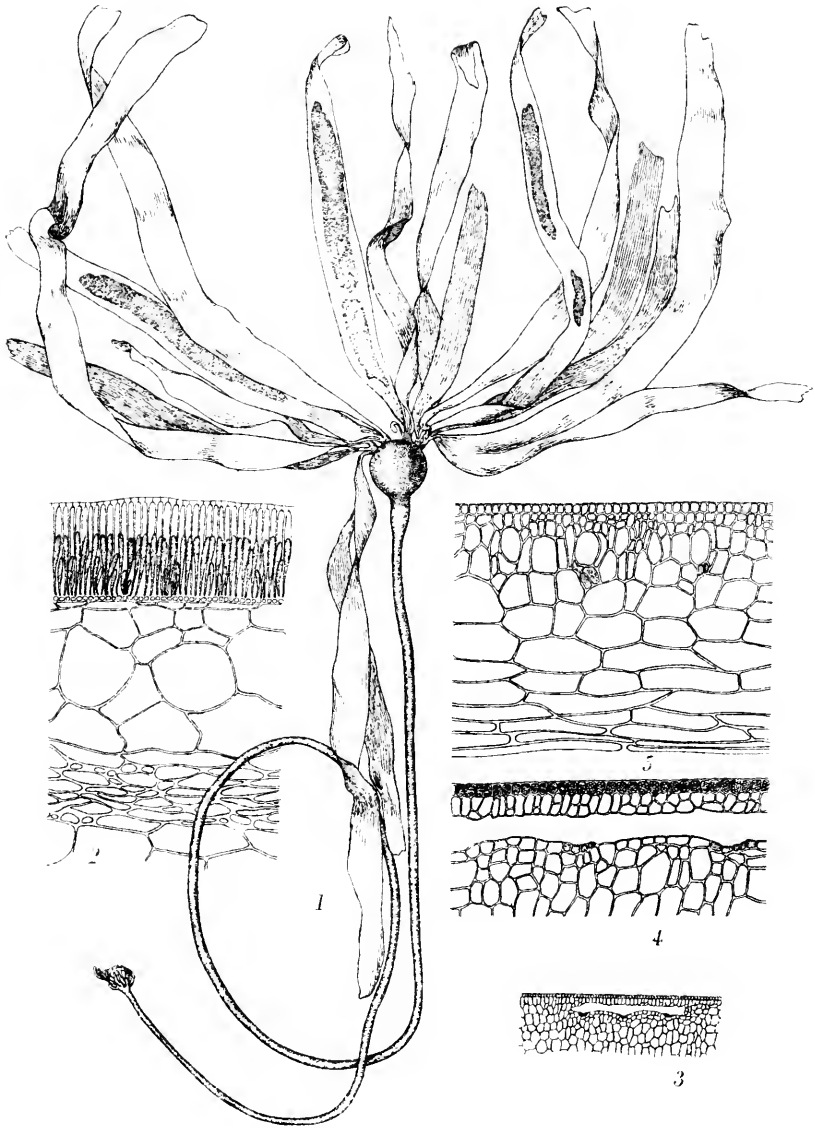


PLATE LIX.

FIGS. 1-8. *Nereocystis frias*, young plants in various stages of development.

9. " " An abnormal plant.

(480)

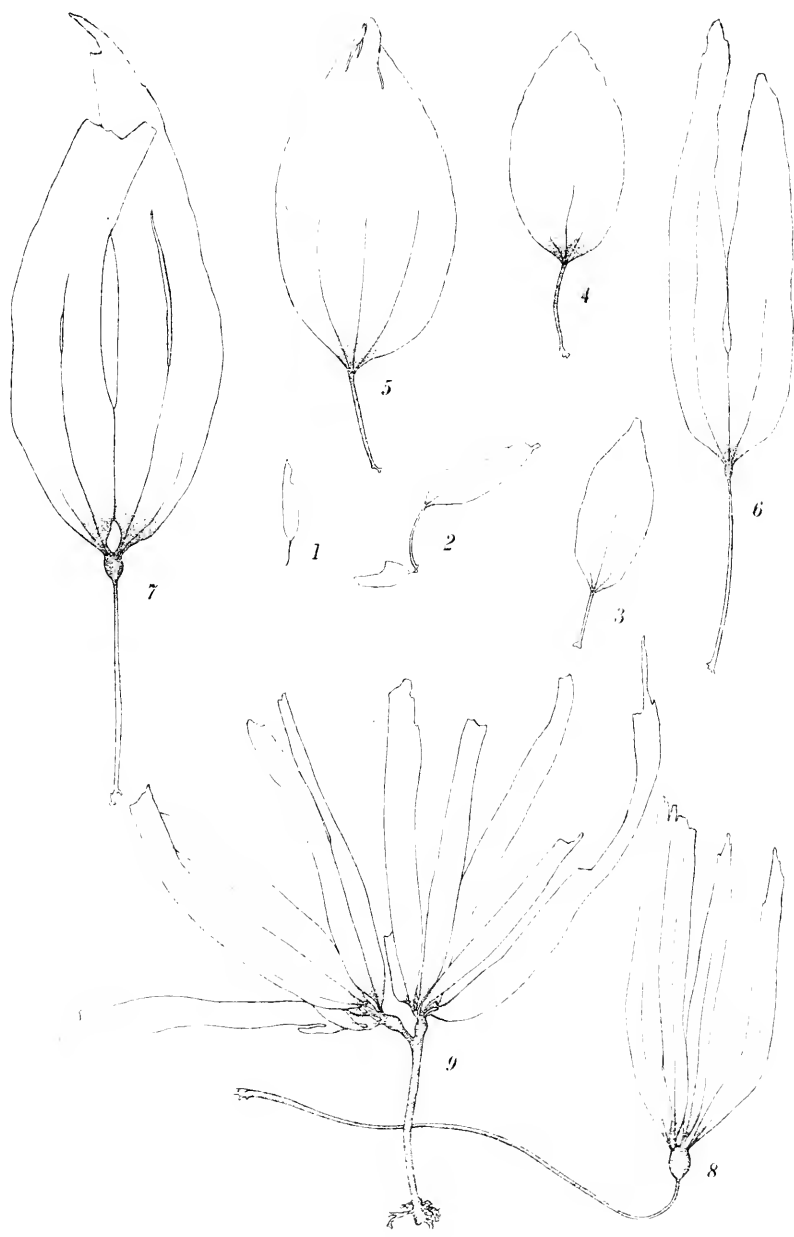


PLATE LX.

FIG. 1. *Macrocystis pyrifera* (Turner) Ag.

2.	"	"	"
3.	"	"	"
4.	"	"	"
5.	"	"	"



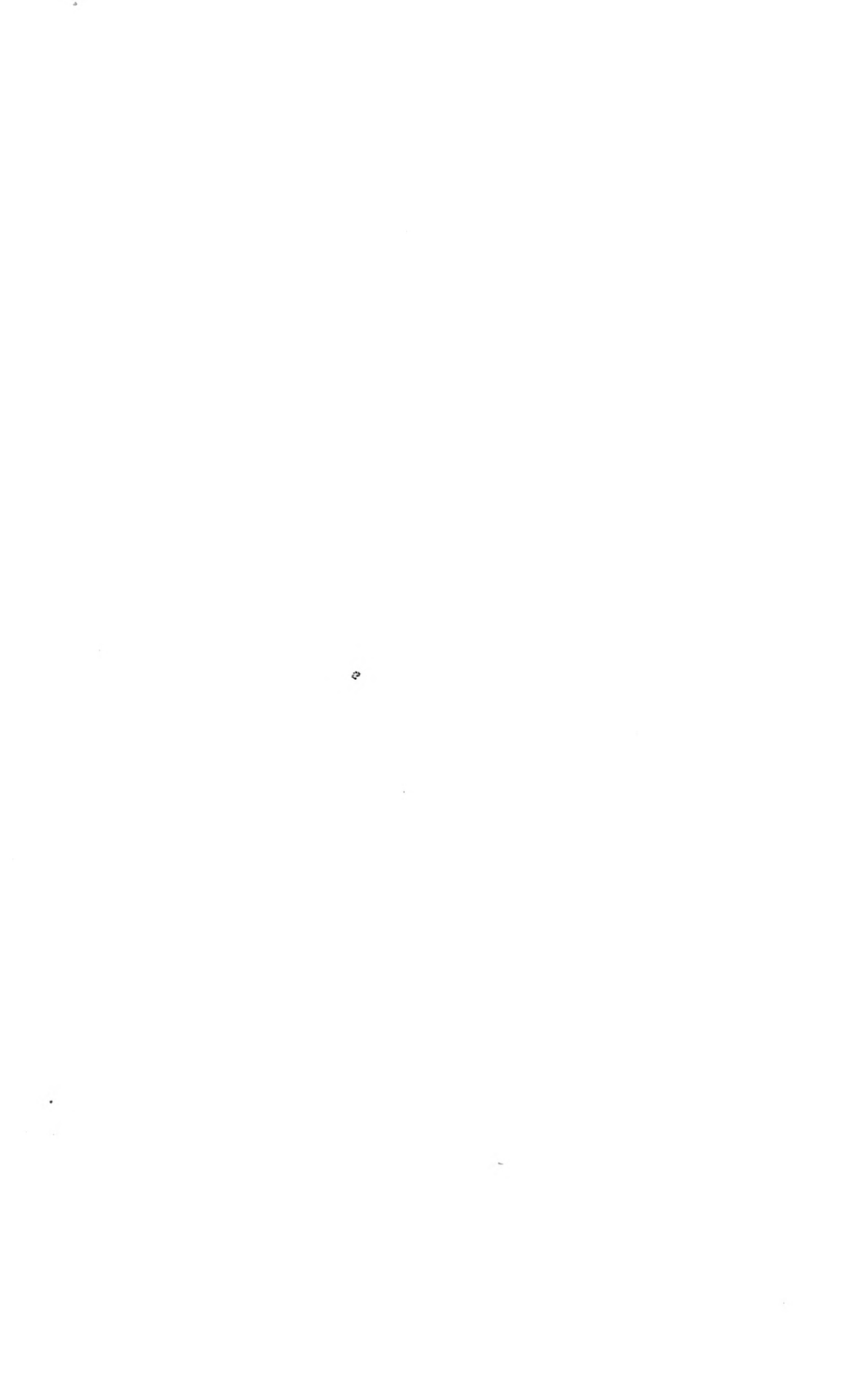


PLATE LXI.

Agarum gmelinii Mert.

(484)

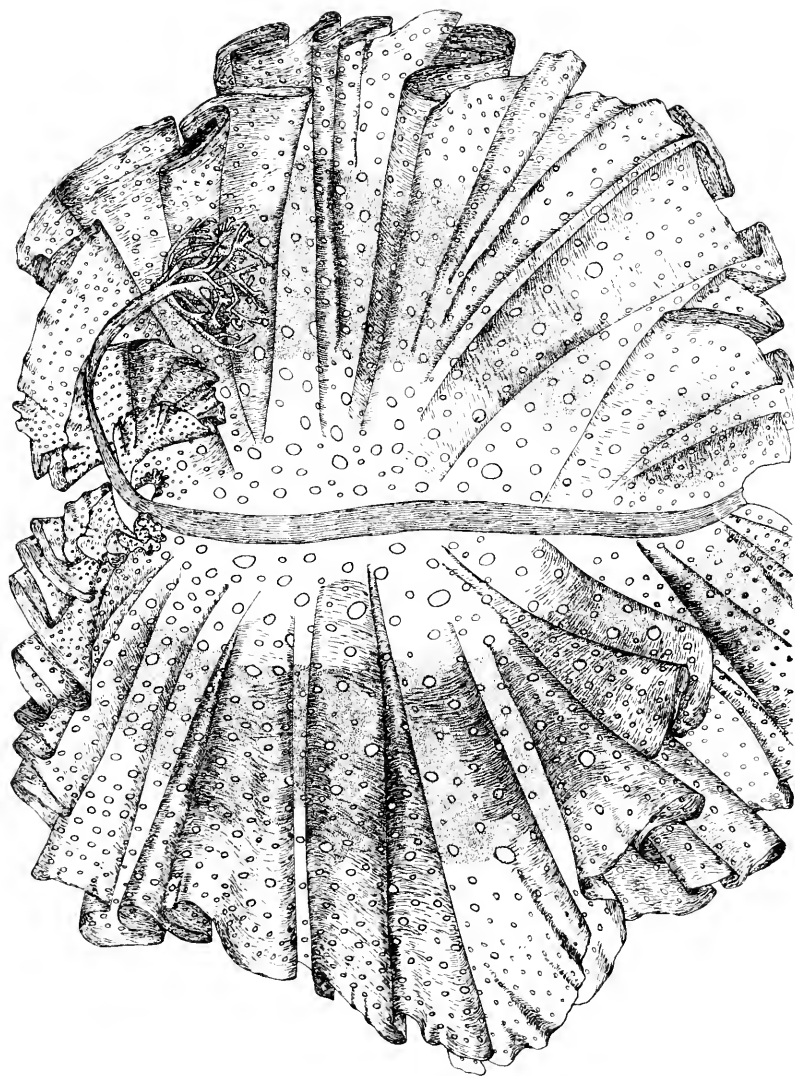
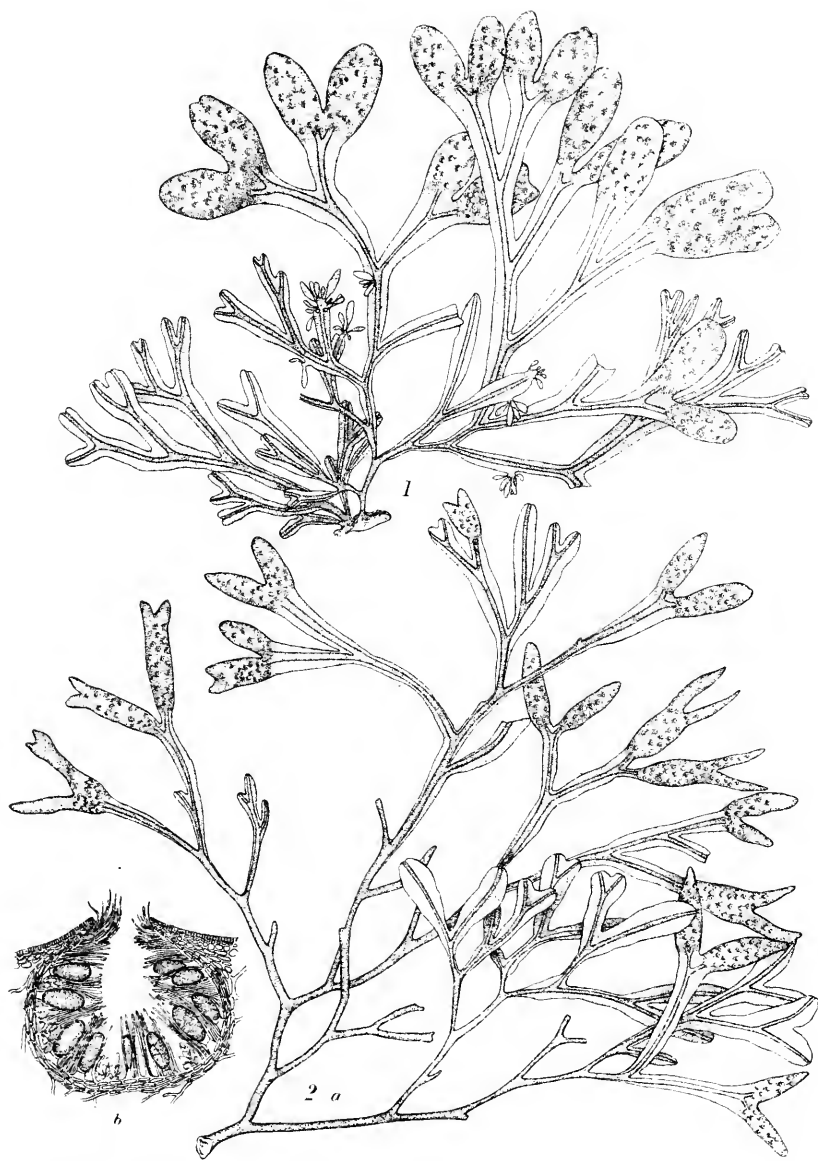


PLATE LXII.

- FIG. 1. *Fucus evanescens* Ag.: forma *macrocephala* Kjellm.
2. " " " forma *cornuta* Kjellm.

(486



PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. III, PP. 487-506.

NOVEMBER 7, 1901.

PAPERS FROM THE HOPKINS STANFORD GALAPAGOS EXPEDITION, 1898-1899.

IV.

ENTOMOLOGICAL RESULTS (4):

ORTHOPTERA.

[TEXT FIGURES 35-44.]

BY JEROME McNEILL.

CONTENTS:

Introduction	487
Technical descriptions.	
Forficulidæ	492
Blattidæ	493
Mantidæ	494
Acrididæ	495
Locustidæ	496
Grillidæ	502

INTRODUCTION.

IN his paper on the Orthoptera of the Galapagos Islands¹ Scudder enumerates eight expeditions which have made collections there. These are Darwin in the *Beagle*, 1835; the Swedish frigate *Eugenie*, 1852; Louis Agassiz, in the *Hassler*, 1872; Commander Cookson, in the *Petrel*, 1875; Wolf, State Geolo-

¹Bull. Mus. Com. Zool., Vol. xxv, No. 1, pp. 1-24, Pl. 1-III, Cambridge, Sept., 1893.

gist of Ecuador, 1875; the *Albatross*, 1888; Alex. Agassiz, in the *Albatross*, 1891; and G. Baur for Clark University, 1891.

Scudder's paper is based on the specimens obtained by all the expeditions except the *Beagle*, *Eugenie* and *Petrel*, and he had seen specimens of all the species enumerated by him, except one, which is of uncertain occurrence. Butler referred two larval mantids to the genus *Vates* and Scudder concludes that it was impossible to have referred the specimens he knew to that genus.

Twenty species of Orthoptera are given in this paper, these species representing all the families except Phasmodæ. All the Blattids, however, five in number, are cosmopolitan species. Of the remaining *fifteen* two are of such doubtful occurrence that they may be excluded, leaving but *thirteen* indigenous species. Moreover, since the forficulid, *Anisolabis annulipes* Lucas, must be regarded as an introduced species, this number must be still further reduced to *twelve*. These twelve are included in eleven genera, representing four families. The Blattidæ and Forficulidæ are represented only by cosmopolitan species, and Phasmodæ is not known. Excluding the few doubtful cases, species are referred to thirty-six localities, or excluding the cosmopolitan forms to twenty-eight.

The above outline of our previous knowledge of Galapagos Orthoptera has been given in order to clearly show the additions made by the Hopkins Stanford Expedition.

Messrs. Snodgrass and Heller spent about six months in the Islands; usually staying only a few days at each one. Albemarle was however twice visited and several weeks spent in its exploration. No special effort was made to collect Orthoptera as the purpose of the expedition was to make as complete collections as possible of the entire fauna and flora of the islands. The insect collecting was done chiefly by Mr. Snodgrass.

The following table exhibits the distribution of the Orthoptera.

It will be seen from this that Orthoptera were obtained from all islands previously visited except two, Jarvis and Gardner, and from four new localities, Narboro, Culpepper, Abingdon and Bindloe. Omitting the cosmopolitan Blattids, which he made no effort to collect, Mr. Snodgrass obtained all the species hitherto known, except two, *Closteridea bauri* Scudd. and

DISTRIBUTION OF ORTHOPTERA IN THE GALAPAGOS ISLANDS.

NOTE. New species in black face type. Localities previously reported are shown by an *, not previously reported, by a †.

Species.	Tower.	Albemarle.	James.	Jarvis.	Duncan.	Indefatigable.	Barrington.	Chatham.	Hood.	Gardner.	Charles.	Narboro.	Culpepper.	Abingdon.	Bindle.
1. <i>Anissolabis annulipes</i>	†	*	†
2. <i>Temnopteryx snodgrassii</i>	†	*
3. <i>Periplaneta americana</i>	†	*
4. <i>Periplaneta australasica</i>	†	*
5. <i>Nauphæta cinerea</i>	*
6. <i>Nauphæta circumvagans</i>	*
7. <i>Leucophaea surinamensis</i>	†	*
8. <i>Galapagia solitaria</i>	*	†	†	†
9. <i>Closteridea bauri</i>	*
10. <i>Sphingonotus fusco-irroratus</i>	†	?	†	†	†	†	*	†
11. <i>Schistocerca melanocera</i>	*	†	*	*	*	†	†	*	†	...	†	...	†	†	†
12. <i>Schistocerca literosa</i>	†	*	†	†	...	*
13. <i>Halmenus robustus</i>	*	†
14. <i>Halmenus cuspidatus</i>	†
15. <i>Halmenus choristopterus</i>	†
16. <i>Desmopleura concinna</i>	*
17. <i>Anaulocomera darwini</i>	†	†	...	*
18. <i>Liparoscelis cooksoni</i>	*	†	†	†	...	†
19. <i>Liparoscelis palludicola</i>	†
20. <i>Liparoscelis pallidus</i>	†
21. <i>Conocephalus insulanus</i>	†
22. <i>Xiphidium exitiosum</i>	†	†
23. <i>Gryllus galapageius</i>	†	*	*	?	†	...	?	†	†	...
24. <i>Nemobius speculi</i>	†
25. <i>Cycloptilum erraticum</i>	†	†	...	*	†	...
26. <i>Cycloptilum lepismoide</i>	†	†

Desmopleura concinna Scudd. In addition to this, he obtained eight new species or two-thirds as many (indigenous species) as had been previously known, besides several subspecies and races not included in the table. These species fall in six genera, three of which had not been previously reported from the Islands. Of these genera one, *Temnopteryx*, belongs to the Blattidæ, a family not hitherto represented in the indigenous fauna. These specimens were obtained in fifty-four localities or excluding the cosmopolitan species in fifty. Thirty-two of these localities, or excluding the cosmopolitan species thirty, are new.

Fifteen of the Galapagos Islands are now known to possess Orthoptera. This number does not include small islets (like

South Seymour) lying so near larger ones that they may be regarded as forming an integral part of them. The number of known species is twenty-six. This number includes six species which are almost certainly cosmopolitan, but excludes the doubtful *Vates* and *Gryllus* given in Scudder's List.

The Hopkins Stanford Expedition, as is obvious, has greatly enlarged our knowledge of the orthopterous fauna of these Islands. But it has done more. By collecting a large series of individuals of the several species it has shown how potent a factor isolation is in the production of species. This example is especially instructive because the differentiation cannot well be explained by natural selection, or by the effect of environment. All the indigenous species are apparently new. Of these 20 indigenous species twelve are incapable of flight. Of the remaining eight, one, *G. solitaria*, has a wingless female; another, *Gryllus galapageius*, is wingless twice as often as winged. Thus nearly seventy per cent. of the native orthoptera are wingless.

Of the native species nine, including the cockroach, mantis, crickets, and the *Liparoscelis* were in all probability brought to the islands on timber or in partially decayed logs, the Mantid, at least, in the egg state. Though nothing is known of *Halmenus*, yet judging from some of its allies, this species may have been introduced in the egg state, the eggs being deposited in partly decayed or at least dead timber. The *Schistocera* and the *Sphingonotus* were almost certainly brought there by their own wings, and it seems probable that the long-winged *Desmopleura* was introduced in the same way. As to the four remaining species there is greater uncertainty. Both *Anaulocomera* and *Conocephalus* have efficient wings but neither are great flyers and it seems very unlikely that they should have been able to keep on the wing long enough to reach the islands. Nor can we readily suppose that they could have drifted in tree tops, since their wings would have tempted them to fly, probably thus ruining their only chance for safety. All things considered, the most reasonable hypothesis is that they were introduced in the egg state, the eggs being attached to twigs or leaves.

To account for the presence of the last two species presents the greatest difficulty of all. Nothing is known, I believe of the habits of *Closteridæ*. Only one species of the *Truxalinæ*, *Chlucaltis conspersa* Harr., so far as I know, has been observed to lay its eggs in wood, and it is possible that either *Closteridea* has, or its ancestors had, the same habit. All the *Xiphidia*, I believe, live on the ground and never on trees, so that its occurrence here is altogether unlikely and I can form no plausible theory of the manner of its introduction. The problem is not simplified by the fact that it is found on two islands, James and Indefatigable.

Albemarle is represented by the greatest number of species (twelve), and this is quite to be expected, since it is the largest of the islands and its greatest length lies across the path of the currents and trade winds. It is on the leeward side of the group. Indefatigable is next in size and, with Chatham, it has the next largest number (seven) of native species. Chatham is fourth or fifth in size and is, I believe, the only one of the islands now inhabited. It is the easternmost of the group. Charles and James have each six representative species. James is probably fourth in size and has no more than its proportionate number of species. Charles is smaller and its relatively larger number of species is probably due to the fact that it has been inhabited and presumably more frequently visited than most of the others. It is difficult to understand why Hood, which is rather smaller than Charles, and has been much less frequently visited, should have the same number of species. The remaining islands, with one exception, are small and three of them—Abingdon, Bindloe and Tower—lie far from the others, so that the small number of species credited to each is natural. The exception referred to is, however, curious.

Narboro ranks second or third in size. It has but three species credited to it and all these are found on Albemarle. This condition of things may be partly explained by the fact that the island is completely cut off from the prevailing currents by Albemarle, so that it is apparently impossible that drift wood should ever reach it from the main land.

All the specimens of orthoptera collected by Mr. Snodgrass

now form a part of the entomological collection of Stanford University, and the types of the new species here described are consequently to be found there.

FORFICULIDÆ.

ANISOLABIS ANNULIPES Lucas.

Forficasila annulipes LUCAS, Am. Soc. Ent. Fr. Bull., 1847, LXXXIV.

Anisolabis annulipes BOR., Biol. Centr. Am. Orth., p. 5.

Anisolabis bormansi SCUDD., Bull. Mus. Comp. Zool., Vol. XXV, p. 5.

Anisolabis maritima? BRUN. (*nec* Bor.), Proc. U. S. Nat. Mus., Vol. XII, p. 192.

Careful examination of numerous specimens has convinced me that Scudder's species is identical with a Pacific coast species, *A. annulipes*. The joints of the antennæ vary in what appear to be full-grown specimens (those 4 or 5 mm. in length have from six to eight joints) from thirteen to nineteen. In many cases, no doubt, the terminal joints are lost. The position of the ring of luteous is quite uncertain. There may be one, two or three joints beyond it and it may include a single joint or as many as three, or it may be absent entirely. A variable number from one to four or more of the basal joints are also luteous. Scudder's description was based upon a single female, consequently his description of the forceps would apply to that sex only. In the male these appendages are very unsymmetrical, the left one being decidedly but regularly curved throughout its length, while the right is bent, rather than curved, not far from the middle, and sometimes the apical half is nearly at right angles to the basal. The femora are only very obscurely banded with fuscous; indeed, in many cases this character is indistinguishable. The specimens from Albemarle are much larger than the others, the largest measuring 20 mm. in length. The same species was found at Clipperton Island, perhaps a thousand miles northwest of the Galapagos group. Snodgrass collected specimens from Albemarle, Chatham and Clipperton. Since all these islands are inhabited, and as this is a cosmopolitan species found in both the new and old world, and as no specimens have been found on any of the uninhabited islands, there can be little doubt that it is an introduced species.

Clipperton, 22 specimens varying from 4 mm. to full grown; Chatham, 4 specimens; Albemarle, 13 specimens, 5 males.

BLATTIDÆ.

Subfamily BLATTINÆ.

TEMNOPTERYX SNODGRASSII sp. nov.

Description.—Dark chestnut, somewhat lighter on the pronotum and tegmina. Labrum, coxæ and femora testaceous; tibiæ and feet chestnut. Pronotum parabolic, the posterior edge barely arcuate,

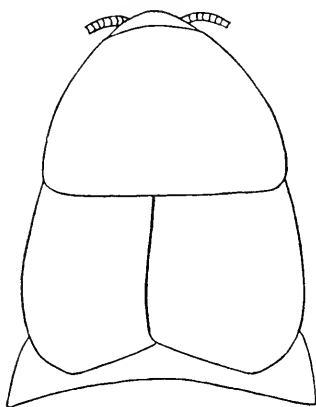


FIG. 35. *Temnopteryx snodgrassii*, female, head, pronotum and anterior part of abdomen, dorsal view. ($\times 8$.)

horny, polished and remotely and shallowly punctate, with the anterior and lateral margins a little lighter than the disk. Tegmina short, not quite covering the first segment of the abdomen, horny, with the veins exceedingly obscure and the anal sulcus entirely obsolete; sutural and costal margins straight and parallel; posterior margin straight and slightly oblique, with the exterior angle moderately rounded. Anterior femora with three spines near the middle of the anterior lower carina, followed by a series of minute spinules on the apical half, no spines on the posterior lower carina; terminal spines $\frac{3}{2}$. Middle and posterior femora with three spines on the anterior lower carina and four on the posterior lower carina; terminal spines $\frac{2}{1}$. Supra-anal plate triangular and slightly keeled (male), or transverse and deeply incised (female). Cerci twice as long as the supra-anal, plate in the median line, somewhat depressed, dark chestnut; stylets of the male very small.

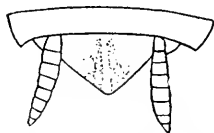


FIG. 36. *Temnopteryx snodgrassii*, female, dorsal view of end of the abdomen. ($\times 8$.)

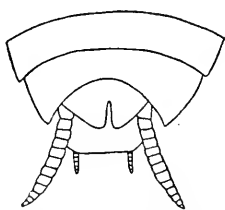


FIG. 37. *Temnopteryx snodgrassii*, male, dorsal view of end of abdomen. ($\times 8$.)

Measurements.—Length of body, ♀ 8 mm., ♂ 7 mm.; tegmina, ♀ 3, ♂ 3; pronotum, ♀ 3, ♂ 3.

This is the only blattid which is probably indigenous. All the other species in the collection belonging to this family and the three previously reported are well-known cosmopolitan forms.

This species is perhaps more closely related to *Temnopteryx sumichrasti* Lucas than to any other, but it is readily distinguished from it by the plain color and by the divided supra-anal plate of the male.

The specimens upon which the species is based were collected at an elevation of 2,000 feet, on the south side of Iguana Cove Mountain, Albemarle Island, on very wet ground covered with an abundant and luxurious vegetation of ferns, shrubs and vines. The specimens were found under leaves. As Mr. Snodgrass searched diligently for insects living under stones and leaves, it is highly probable that the species is restricted to this single locality. One of the specimens contains, partly extruded from its body, a species of *Gordias* (?).

Albemarle, 1 male, 3 nymphs.

Subfamily PERIPLANETINÆ.

PERIPLANETA AUSTRALASIA Fabr.

Previously recorded by Bruner from Charles Island. No effort was made to collect blattids, as they were supposed to be cosmopolitan species entirely.

Chatham: 1 male.

Subfamily PANCHLORINÆ.

LEUCOPHÆA SURINAMENSIS Linn.

Two immature specimens from Chatham, both females.

Three previous expeditions to the Galapagos have reported this species from Charles and Chatham.

MANTIDÆ.

Subfamily MANTINÆ.

GALAPAGIA SOLITARIA Scudd.

The collection contains eleven specimens from three localities. Seven of them are from Albemarle, the island from which came the single male and female on which Scudder's description is based. These should, therefore, be typical specimens but they are all dull brown in color instead of clay-yellow, the females usually having the pronotum and especially the abdomen with three longitudinal fuscous stripes on an obscure testaceous ground. The males, however, and especially the single adult, are grayish-brown with the tegmina of the same color but with the cross-veins on either side of the main veins

deep fuscous. The specimens from Indefatigable are so different in size and color that they deserve to rank as a distinct subspecies. The adults are very light testaceous with the cross-veins of the tegmina not at all infuscated. Both forms have a very marked depression on the inner side of the anterior femora for the reception of the tibial spur, and beyond this impression three large spines. The Albemarle form, which may be called *typicalis*, has distad to this impression four spines on the outer and eight on the inner side; the Indefatigable form, which may be called *major*, has five and ten spines respectively.

Length of body, *typicalis*, 40 mm., *major*, 41 mm.; tegmina, *typicalis*, 25 mm., *major*, 28 mm.; hind femora, *typicalis*, 12.5 mm., *major*, 18 mm.

Albemarle, 1 male, 2 females, 4 nymphs; Indefatigable (South Seymour Island), 2 males, 1 female; Hood, 1 nymph.

ACRIDIDÆ.

If we exclude the doubtful *Vates* and *Gryllus*, the only two indigenous species previously described from the Galapagos which are not found in the present collection belong to the family Acrididæ. These species are *Closteridea bauri* Scudd., a truxalid, and *Desmopleura concinna* Scudd., an acridid. The four other previously known species were collected in large numbers and Mr. Snodgrass has prepared a paper dealing with their variations and distribution.

Subfamily ŒDIPODINÆ.

SPHINGONOTUS FUSCO-IRRORATUS Stål.

Numerous specimens from six islands, viz.: Charles, 11 males, 28 females; Albemarle, 4 males, 9 females; Barrington, 1 male, 8 females; Hood, 3 males, 7 females; Chatham, 4 males, 14 females; Indefatigable, 13 males, 31 females.

Subfamily ACRIDINÆ.

SCHISTOCERCA MELANOCERA Stål.

Represented by numerous specimens which, as Mr. Snodgrass has shown, are separated into distinct races which generally but not always have their range limited by the geographical division of an island.

Specimens were collected on Charles, Albemarle, Barrington, Indefatigable (South Seymour), James, Narboro, Duncan, Abingdon, and Bindloe.

SCHISTOCERCA LITEROSA Walk.

Taken on Chatham, Tower, and Hood.

HALMENUS ROBUSTUS Scudd.

In addition to this species heretofore recognized in the specimens from Indefatigable, there are, on James, two other quite distinct forms which I am inclined to consider of specific value.

Indefatigable, 2 males, 6 females.

HALMENUS CUSPIDATUS Snodgrass (MS.).

This form is represented by so many specimens that there seems little doubt that the species is a good one.

Albemarle, 2 males, 5 females.

HALMENUS CHORISTOPTERUS Snodgrass (MS.).

This form is unfortunately represented in the collection by only a single specimen.

Charles, 1 female.

LOCUSTIDÆ.**Subfamily PHANEROPTERINÆ.****ANAULOCOMERA DARWINII** Scudd.

The collection contains a single pair which agree well with the published description, except that the anterior and middle femora have no trace of spines on the lower surface.

James, 1 female. Indefatigable, 1 male.

LIPAROSCELIS Stål.

Nesacia SCUDD., Bull. Mus. Comp. Zool., Vol. xxv, 1893, No. 1, p. 20.

Thirty-seven specimens of this genus are in the collection, taken from six of the islands, which are, however, very unequally represented. Twenty-six specimens are credited to Albemarle while Indefatigable has but a single larva, and Barrington and James a single adult each. So great is the difference among these specimens that it is necessary to recognize three species and one subspecies, or probably four species, and each of the islands represented possesses at least one distinct variety. All of these forms are, without doubt,

more closely related to each other than to other species of the genus, and all are easily separated from their congeners. In 1895, Brunner, in his *Monographie der Pseudophylliden*, assigned four species to this genus, two being from Mexico and one from Colombia. *Liparoscelis cooksoni* is at once distinguished from two of these species by its smooth face. It is probably much more closely related to the remaining species, *L. nigrispinis* Stål, but is readily distinguished by the fewer spines on the under side of the fore and middle femora and by the acute unemarginate subgenital plate and straight ovipositor of the female.

Albemarle, 26; Indefatigable, 1 larva; Barrington, 1; James, 1.

LIPAROSCELIS COOKSONI Butler.

Agracia cooksoni BUTL., Proc. Zool. Soc. Lond., 1877, pp. 87-88.

Bucrastes? cocoannus? BRUN. (*nec* Boliv.), Proc. U. S. Nat. Mus., Vol. XII, p. 192.

Nesecia cooksoni SCUDD., Bull. Mus. Comp. Zool., Vol. XXV, 1893, No. 1, p. 20.

Liparoscelis cooksoni BRUN., Monag. Pseudophyl., p. 176, 1895.

Butler's type was from Charles, so there is no doubt as to the forms to which his name applies. True, he had some immature specimens from Albemarle, and some or all of these may have belonged to another species. Brunner's specimen was from Charles and its identification may be considered certain. As Scudder's specimens (except a single immature one from Indefatigable) came from Albemarle, they probably belong here, though they are somewhat larger than my specimens from the same locality, and the ovipositor is more than proportionally longer; however, this may be due to the fact that the method of measuring this organ used by Scudder and myself are different. He measures a straight line from the tip to the junction of the upper and lower laminae where they leave the body; in other words he measured the chord and I the arc. If the *curvature* was measured, and especially, in this case, if the keel of the lower lamina was measured, the length here given would be increased two or three millimeters.

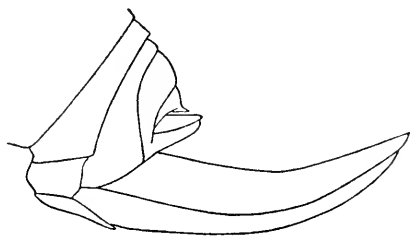


FIG. 38. *Liparoscelis cooksoni* Butler, female, ovipositor and end of a abdomen.

Brunner gives Scudder's measurements and they are exactly the same, except that he adds the length of the four femora, so that his specimens were the same as Scudder's. His description does not fit the Albemarle specimens in all respects, but on the whole it suits this species better than any other.

To this species are referred the specimens from Charles Island, a part of those from Albemarle, and those from James and Hood. The specimens from Hood, however, form a distinct subspecies and, as before stated, each of the islands probably has its distinct race which cannot be properly characterized here for want of material. The Charles race, however, is decidedly larger and more robust than the others; the tegmina overlap plainly in the females; the spines of the under side of the femora are 2 or 3, 2, 4, and the spinules on the outer carina of the upper side of the hind tibiae are 2 or 3. The Albemarle specimens are decidedly smaller; the tegmina of the females scarcely more than touch at the base on the basal half; the femoral spines are 3 or 2, 2 or 3, 4 or 5; the hind tibiae spinules (outer carinae upper side) 4 or 5 or none beyond the middle. The James form is represented by a male only, and it must be compared with the male of the Albemarle form as there is no male from Charles. Compared with this form, the male has the spinules on the outer carinae of the upper side of the hind tibiae uncertain in number and so exceedingly minute as to be scarcely discoverable. The musical organ occupies about one-third instead of one-half the length of the tegmina, and the stylets of the subgenital plate much exceed (by their whole length and a part of the plate equal to half their length) the cerci. These forms resemble each other in having the pronotum strongly tuberculate, the tegmina of the female decidedly shorter and little if any longer than the pronotum, the spines of the hind femora being generally four, the spinules of the

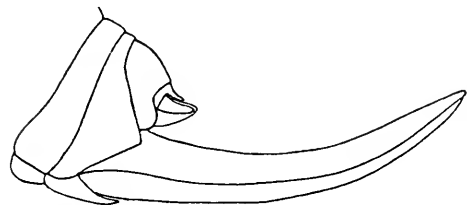


FIG. 39. *Liparoscelsis cooksoni ensifer*, female, ovipositor. ($\times 3$.)

outer carinae of the hind tibiae never more than five and confined to the distal half, and the ovipositor comparatively short and wide and quite strongly curved.

The remaining form is of subspecific value and may be known as *Liparoscelsis cooksoni ensifer* (Fig. 39)

from its comparatively long and gracefully curved ovipositor. It differs from *L. cooksoni* Butler in the following particulars: It is relatively

more slender and more compressed; disk of the pronotum only obscurely tuberculate and moderately rugose; tegmina of the female at least as long as those of the male, decidedly longer than the pronotum; femoral spines, 3, 3, 5; spines of the outer carinae of the upper side of the hind tibiae eight, occupying the distal three-fourths; cerci of the male short, exceeded by the subgenital plate (exclusive of the stylets) by at least their own. length; ovipositor of the female long, decidedly curved and slender.

Hood, 1 male, 2 females, May 13 and 14.

Measurements are: Length of body, ♂ 34 mm., ♀ 33; pronotum, ♂ 6.5, ♀ 7; tegmina, ♂ 9, ♀ 9; hind femora, ♂ 17, ♀ 18; length of ovipositor, ♀ 14.2; width of ovipositor, 2.

Charles, 2 females, 6 nymphs, May 9.

Measurements of female: Length of body, 37.5 mm.; pronotum, 7 to 8; tegmina, 7; hind femora, 18.5 to 19; ovipositor, 11.5 to 12.

Albemarle, 1 male, 2 females, June 9 and 12.

Measurements.—Length of body, ♂ 27 to 28 mm. ♀ 25 to 28; pronotum, ♂ 6.2 ♀ 6.5; tegmina, ♂ 8 to 8.7, ♀ 5.5; hind femora, ♂ 13, ♀ 14; length of ovipositor, ♀ 10 to 10.5; width of ovipositor, 2.5.

James, 1 male, 1 larva.

Measurements of male: Length of body, 28 mm.; pronotum, 6; tegmina, 8; hind femora, 14.5.

Indefatigable, one larva.

LIPAROSCELIS PALUDICOLA sp. nov.

Description.—Color nearly uniform chestnut brown except the sides and top of the head, which are grayish and the face an hour-glass-shape and the disk of the pronotum which are light clay color. The

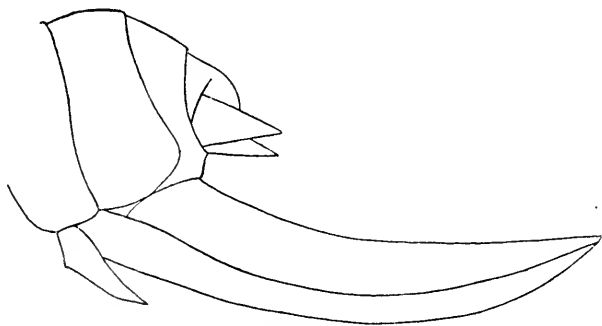


FIG. 40. *Liparoscelis paludicola*, female, ovipositor. ($\times 3$.)

pronotum is obscurely tuberculate on the disk, with a distinct median sulcus which is colored like the body but fades out on the front edge of the prozone and on the posterior part of the metazone. The tegmina of the male are but slightly longer than those of the female; in both they are much longer than the pronotum, and oblong in shape, with the apex rounded. The femoral spines are usually 3-2-4; the spines on the outer carinæ, upper side of the tibiæ about three confined to the distal half. The cerci are not exceeded by the stylets of the subgenital plate. The ovipositor is very stout and moderately curved.

This species is closely related to *L. cooksoni* but easily distinguished by its peculiar coloration as well as by its size and several structural characters. According to Mr. Snodgrass, it is confined to mangrove swamps, where it is found under the bark of *Avicennia*, a tree which always occurs with the mangrove. Specimens were numerous at Tagus Cove and a single one was found in a mangrove swamp at Elizabeth Bay. The species is sluggish in its habits, and its song was not heard.

Measurements.—Length of body, ♂ 40 mm., ♀ 42; pronotum, ♂ 6, ♀ 6; tegmina, ♂ 10-12, ♀ 10; posterior femora, ♂ 14, ♀ 19; length of ovipositor, 16; width of ovipositor, 3.

Albemarle, 12 males, 6 females.

LIPAROSCELIS PALLIDUS sp. nov.

A single specimen, rescued from a mocking-bird, is so different from all the others that, although it is without a head or forelegs, or middle legs, I feel obliged to make it the type of a new species. The following is a description:

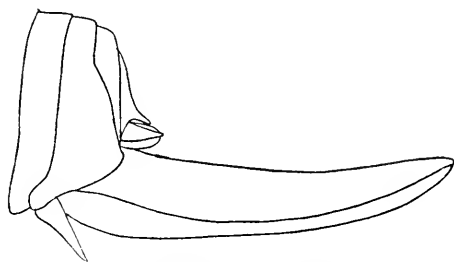


FIG. 41. *Liparoscelis pallidus*, female, ovipositor. ($\times 3$.)

Description.—Yellowish-white, body and limbs mottled with purple, becoming black on the pronotum; ovipositor whitish on the basal, black on the distal half. Pronotum evenly and rather strongly tuberculate, the two

transverse sulci distinct, the median sulcus apparent only at the principal transverse sulcus; shoulders somewhat distinct on the metazone, obsolete on the prozone; posterior margin straight; lateral lobes

with the posterior margin very slightly sinuate and distinctly less oblique than the anterior margin. Tegmina ovate, subacuminate, touching only at the base, with the median and radial veins distinct and the dorsal angularly separated from the lateral field. Hind femora armed below on the distal half with seven spines, the first two minute; hind tibiæ armed above with three spinules on the outer and nine on the inner carinæ. Ovipositor only slightly curved on the upper, more decidedly on the lower margin; subgenital plate triangular acute.

Measurements.—Length of body (estimated), 37 mm.; pronotum, 6.5; tegmina, 10; hind femora, 17.5; length of ovipositor, 14; width of ovipositor, 2.5.

Barrington, 1 female.

Subfamily CONOCEPHALINÆ.

CONOCEPHALUS INSULANUS Scudd.

It is rather remarkable that this species is known only from Chatham. Mr. Snodgrass reports that it was common in a wet pasture about 1,000 feet above sea level. It was not found elsewhere. Three of the males and one female nymph are brown. In this variety the tegmina are maculate pretty evenly with obscure fuscous. Besides the fuscous stripe which borders the stridulating organ in both varieties, the brown specimens have the upper half of the lateral lobes of the pronotum infuscated, and this color is continued as a stripe on the tegmina bordering the radial vein. The lower half of the lateral lobes is also infuscated more or less, and this region is separated from the upper part by a moderately distinct stripe of the lighter ground color.

Chatham, 5 males, 3 females, 4 nymphs.

XIPHIDIUM EXITIOSUM sp. nov.

Description.—Color, green with the usual dorsal stripe on the head and pronotum. Pronotum widens posteriorly and continues to the hind margin; it is darkest medianly and on the edges. The vertex is only slightly pinched at the eyes and is scarcely wider than the basal joint of the antennæ. The posterior border of the lateral lobes of the pronotum is scarcely perceptibly sinuate. The posterior femora are nearly as long as the body, unarmed beneath. The ovipositor is at least three-fourths the length of the hind femora and is very slightly curved.

This species is closely related to *X. nemorale* Scudd., from which it differs strikingly in color. It is also readily distinguishable by the

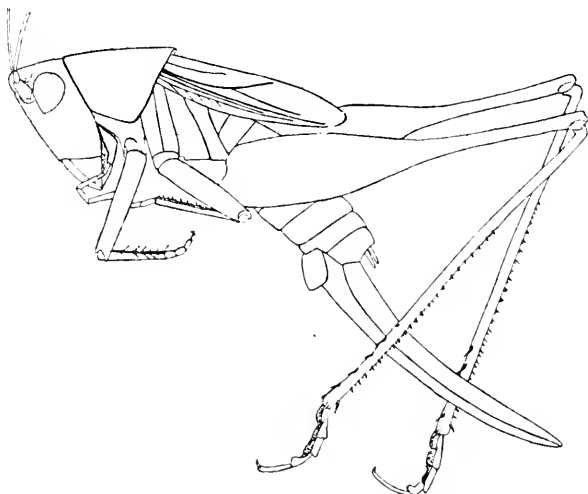


FIG. 42. *Niphidium exitiosum*, female, lateral view. ($\times 3$.)

length of the tegmina which are much shorter in the male and much longer in the female, and by the longer and straighter ovipositor.

Measurements.—Length of body, ♂ 15 mm., ♀ 17; tegmina, ♂ 6, ♀ 8; hind femora, ♂ 12, ♀ 16; length of ovipositor, 12.

Indefatigable, 1 female, 2 nymphs; James, 2 males, 2 females, 1 nymph.

GRILLIDÆ.

Subfamily GRILLINÆ.

GRYLLUS GALAPAGEIUS Scudd.

This species is represented in the collection by a considerable series taken in seven of the islands. The variation in size is considerable as indicated by the measurements, and the color variation (especially among the immature) is quite marked. Less than one-third of the adults (three males and three females) are winged. The obscure, minute, reddish spots are always present in the females, but are generally entirely wanting in the male. On the other hand, while the females show considerable uniformity in the color of the tegmina, these are entirely black in males from Albemarle and Narboro, and wholly testaceous in a single male from Culpepper. The variation in color

among the immature specimens is much more marked, but I believe they all belong to the same species. Five specimens from Culpepper and one from Abingdon are testaceous mottled with fuscous. Two specimens from Tower and one from Hood have the general body color, which is black, considerably varied with testaceous on the pronotum and abdomen. Eight other specimens from Hood and two from Albemarle are entirely black, except for the hind femora which are always either plainly or obscurely transversely barred with fuscous on a testaceous ground, and sometimes, also, a pair of minute reddish spots on the disk of the pronotum and very obscure testaceous or reddish spots on the abdomen and pronotum. Scudder was unable to distinguish the tympanum on the inner side of the anterior tibiae. It is present in all these specimens though minute.

The examination of 42 specimens of *Grylli* of all ages from seven of the islands compels the conclusion that the second species of this genus, which Scudder thought to be indicated by three immature specimens from Charles, probably does not exist; at the same time the absence of all specimens of this genus from Charles leaves the matter in doubt.

Measurements.—Length of body, ♂ 14 to 23 mm., ♀ 18 to 22; tegmina, ♂ 7.5 to 14, ♀ 10 to 14.5; hind femora, ♂ 10 to 14, ♀ 14; ovipositor, 18 to 19.

Of its song, Mr. Snodgrass says it “consists of a continuous chirping sound differing from the intermittent sound made by the small tree crickets (*Cycloptilum*) found in swamps.”

Albemarle, 3 males, 2 nymphs; Hood, 3 males, 8 females, 9 nymphs; Chatham, 2 males, 2 females, 1 nymph; Tower, 2 nymphs; Abingdon, 1 nymph; N Harbor, 1 male; Culpepper, 1 male, 6 nymphs; uncertain, 1 female.

NEMOBIUS SPECULI sp. nov.

Description.—Dark brown more or less varied with testaceous. Sometimes the lighter color predominates but usually the darker, except in the legs which are always obscure testaceous banded more or less regularly with brown. The face, occiput and disk of the pronotum are obscure testaceous maculate with brown; on the posterior part of the disk the markings are minute round spots; the lateral lobes of the pronotum are brown with about seven round light spots, five above and two below; the veins of the tegmina are for the most part testa-

ceous. The frontal costa is rather thickly pilose with stiff black hairs. The antennæ are about four times as long as the body. The pronotum is only slightly narrowed anteriorly, less than one and a half times as wide as long and usually sparsely pilose with long bristly hairs. Teg-

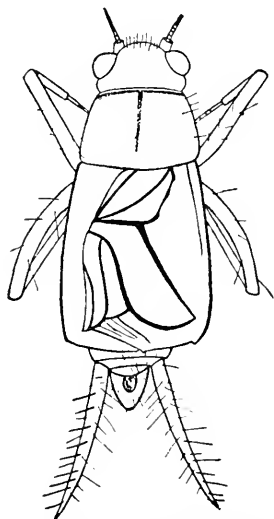


FIG. 43. *Nemobius speculi*, male, dorsal view except hind legs. ($\times 8$.)

mina of the male about two-thirds as long as the abdomen, truncate or very slightly arcuate posteriorly with the external and internal posterior angles extended into rather distinct spines; speculum very large, including nearly all of the dorsal field, the apical field therefore very much reduced; wings apparently obsolete. The anterior and middle femora are strongly compressed, the latter decidedly arcuate. The posterior tibiæ are armed with three spines on both the inner and outer angles; these spines are situated on the apical half, the lowermost inner one being half as long as the tibiæ and about as long as the metatarsus; spurs of the posterior tibiæ, three, on both the inner and outer side, the upper inner one being about as long as the metatarsus, the latter a little less than twice as long as the two joints of the tarsus. Cerci about as long as the head

and pronotum. Ovipositor of the female of uncertain length, not toothed at the tip.

Measurements.—Length of body, 5 mm.; tegmina, 2.5; hind femora, 4.

The collection contains about twenty-three specimens of *Nemobius*, all collected at the same time in a single locality. Unfortunately only two of them are mature, and both are males, though a considerable number of both males and females

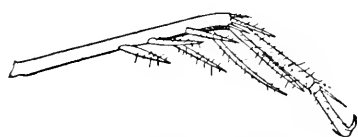


FIG. 44. *Nemobius speculi*, male, posterior tibia. ($\times 8$.)

are in next to the last moult. Since the tables for determining species in this large genus (at least forty-five species are described) are generally based on the females, and since in many cases the males are not known, I have not been able to satisfactorily determine the position of this species; but since all species indigenous to the Gala-

pagos have proved to be new, the following description is given without much fear of its specific distinctness.

Albemarle, Tagus Cove, 2 males, 20 nymphs.

Subfamily MYRMECOPHILINÆ.

CYCLOPTILUM ERRATICUM Scudd.

This species has been known heretofore by a single specimen, a male from Charles Island. The present collection contains five adults and several nymphs. The female is so unlike the male in appearance as to make it difficult to recognize it as belonging to the same species. The best preserved specimens are dull cinnamon brown, especially anteriorly, becoming chestnut posteriorly, with the legs sometimes lighter. The surface of the body and legs is smooth or very sparsely pilose. The female is wingless with the pronotum subquadrate, very moderately widening posteriorly, and not covering the mesothorax. The ovipositor is as long as the hind femora. A few scales are found on the under side of the body and sometimes a single row bordering some of the abdominal segments. The antennæ are about twice as long as the whole body.

It occurs in mangrove swamps on the under side of leaves and under the bark of dead trees, and is reported to be numerous, but shy and difficult to catch. Mr. Snodgrass says: "Their singing can be heard the whole day in the swamp. It consists of an intermittent chirping sound, the intervals between the series of chirps being short, however, so that the whole has a continuous sound, but it is readily distinguished from the louder and continuous chirping of the large cricket living everywhere beneath the rocks." Two of the specimens from Albemarle, apparently young males, though the pronotum is very small, have large tegmina and wing pods.

Albemarle, 3 males, 1 female, 5 nymphs; Hood, 1 male.

CYCLOPTILUM LEPISMOIDE sp. nov.

This species is remarkable among Orthoptera for the possession of scales. Though this character is shared by other species of the genus *Cycloptilum*, it is much less evident. *C. lepismoide* differs from *C. erraticum* in its color, which is very dull brown, becoming blackish posteriorly. The legs are quite thickly pilose, and these, together with the under surfaces, are luteous or white varied with black. The

white and black of the under surface and the black of the head is due to the presence of thickly imbricated scales. These scales are of various forms but possess the common characters of a prominent carina, which ends distally in a point, and a complicated sculpture. This sculpturing consists of thickened plates which are arranged in rows parallel, approximately, to the median carina, and also in rows forming a right angle with the first set. Under a moderate power of the microscope the appearance presented is that of concentric curved depressions running lengthwise of the scale, and less evident depressions curving radially from the midrib. The legs, and especially the posterior pair, are plainly shorter and more robust. The last abdominal segment of the male is shaped like the bow of a boat and from its apex extends a pair of minute forked appendages which are approximate nearly throughout their length. The anal cerci are quite as long as and distinctly stouter than in *C. erraticum* and they are quite thickly pilose with hairs, the longest of which are more than twice as long as the diameter of the cerci at the base. On account of these hairs the cerci appear much stouter.

Measurements.—Length of body, ♂ 6.5 mm., ♀ 9; pronotum ♂ 3.5, ♀ 2; hind femora, ♂ 3.5, ♀ 5.

Except for the omission of any mention of scales, Scudder's description of *Cycloptilum erraticum* would appear almost equally well to each of these species. It seems unlikely that he has overlooked so striking a character as this, however, and the smaller size of the only adult male of *C. lepismoide* has determined me to consider this one as the undescribed form.

Found on the leaves of bushes and possibly also on the leaves of the mangrove.

Albemarle, 1 male, 1 nymph; Narboro, 6 nymphs; Abingdon, 1 female.

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SYNONYMY OF THE FISH SKELETON.

[PLATES LXIII-LXV. TEXT FIGURES 45-46.]

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INTRODUCTION.

IN works on the fish skeleton much confusion of nomenclature has arisen from the difficulty of homologizing the bones with those of the higher vertebrates. Some authors have attempted to homologize every element in which there is a trace of homology while others have only homologized those in which it is most evident, giving special names to the remaining ones. These special names have not caused confusion, as each has been used consistently for the bone to which it was originally assigned; but names involving the assertion of homology have frequently been applied to more than one element, according to the different interpretations of different authors. Thus the word *coracoid* (in some of its forms) has been applied to four distinct bones of the shoulder girdle.

This troublesome confusion is not confined to the older writings, but still continues. The present paper has been prepared as a key to the labyrinth.

In the accompanying plates and text figures¹ each element of the skeleton is numbered, and under corresponding numbers in the text the synonymy of each term is given. The terms first given, though perhaps not always the best, are in the most general use by English writers and are therefore here adopted. These terms form a nomenclature for which Owen and W. K. Parker are chiefly responsible, though Huxley and Gill have contributed to it.

Personal names indicate the nomenclature adopted. The first name after a term is generally that of the author who first so used it.

The nomenclature of Cuvier, Owen, Günther and Parker is given in full, that of other anatomists only where they differ from these authors.

I have had some difficulty in determining the identity of a few of the elements described by Erdl in his paper on the skeleton of *Gymnarchus niloticus* published in Akademie der Wissenschaften, 1847. In Sir Richard Owen's personal, interleaved, annotated copy of his Lectures on Comparative Anatomy, which is in my possession, I find, among many other notes, his interpretation of some of these elements. When it has seemed advisable I have added his notes, or commented on them.

Synonymic lists published by Sir Richard Owen on the skull;² by Dr. Albert Günther on the entire skeleton;³ and by Dr. Theo. Gill on the shoulder girdle,⁴ have been of great help in preparing this paper.

LIST OF SYNONYMS.

1. **Vomer.** Cuvier, Owen, Stannius, Günther, Parker and many others.

Anteal. Gill.

¹Made from drawings by Chloe Lesley Starks.

²Owen, Lect. on the Comp. Anat. and Phys. of Vert. Anim., Pt. 1, Fishes, London, 1846.

³Günther, Introd. to the Study of Fishes, Edinburgh, 1880.

⁴Gill, Arrang. of Fam. of Fishes, Wash., D. C., 1872.

Pflugschar. Meckel.

Pflugschaarbein, vomer. Erdl.

Rhinosphepal. Geoffroy.

2. **Ethmoid**. Cuvier, Günther, Parker. Not *ethmoid* of Owen, No. 14; nor *ethmoideum* of Erdl, No. 3; nor of Vogt and Yung, No. 16.

Crista ethmoidei. Bojanus.

Nasal.¹ Owen, Vogt and Yung. Not *nasal* of Cuvier, No. 51.

Nasentheil des Stirnbeines, nasalis ossis frontis. Erdl.

Os ethmoideum. Stannius.

Prosethmoid. Gill.

Riechbeinkörper. Meckel, Wagner.

Siebbein. Köstlin.

3. **Prefrontal**. Owen, Gill.

Ecto-ethmoid. Parker (W. K.).

Ethmoideum cribrosum. Bojanus.

Frontal antérieur. Cuvier, Agassiz.

Lateral ethmoid. Parker.

Lachrymal. Geoffroy. Not *lachrymal* of Parker, No. 49.

Orbitalflügel des Keilbeins. Müller.

Os frontale anterius. Stannius.

Parethmoid. Parker (T. J.).

Riechbein, os ethmoideum. Erdl. Not *ethmoideum* of Hallmann, No. 2; nor of Vogt and Yung, No. 16; nor *ethmoid* of Cuvier, No. 2; nor of Owen, No. 14.

Seitlichen Riechbein. Meckel, Wagner.

Thränenbein.² Erdl.

4. **Frontal**. Owen, Parker, Geoffroy and in general use.

Frontal principal. Cuvier, Agassiz.

Mittlerer Stirnbein, frontalis ossis frontis. Erdl.

Os frontale. Stannius.

Stirnbein. Meckel, Wagner.

5. **Sphenotic**. Parker.

Ala magna ossis sphenoides. Erdl.

Frontal postérieur. Cuvier, Agassiz.

Os frontale posterius. Stannius.

Post frontal. Owen, Gill.

¹ *Nasale* oder *mittleres ethmoideum*. Vogt and Yung.

² "Von anderen würde diesen Knochen als Thränenbein gedeutet worden sein." Erdl, *op. cit.*, p. 209.

Schläflbeinschuppen. Bojanus.

Temporal. Geoffroy. Not *temporal* of Vogt and Yung, No. 9; nor of Cuvier, No. 17.

6. **Parietal.** Owen, Parker, Günther.

Os parietale. Stannius, Erdl.

Scheitelbein. Meckel, Wagner, Erdl.

7. **Epiotic.** Parker.

Epioticum. Huxley.

Exoccipital. Geoffroy. Not *exoccipital* of Owen, No. 11.

Occipital externe. Cuvier, Agassiz.

Os occipital externum. Cuvier, Vogt and Yung.

Os mastoideum. Hallmann.

Zwischen-scheitelbein, os interparietale. Erdl. Not *interparietal* of Cuvier, No. 8.

Paroccipital. Owen, Günther.

Seitlichen obern Hinterhauptbeine. Meckel, Wagner.

8. **Supraoccipital.** Owen, Parker, Günther.

Hinterhauptschuppe. Meckel, Wagner.

Interparietal. Cuvier. Not *os interparietal* of Erdl, No. 7.

Occipital supérieure. Cuvier.

Os occipitale superius. Stannius, Vogt and Yung.

Schuppentheil des Hinterhauptsbeins, occipitalis ossis occipitis. Erdl.

Supra-occipitale. Gill.

Squama occipitalis. Hallmann.

9. **Pterotic.** Parker, Huxley.¹

Ecaillé du temporal. Agassiz.

Exrupéal. Geoffroy.

Felsenheil. Bojanus.

Gehördeckel, operculum pori acoustici. Erdl.²

Mastoid. Owen, Günther. Not *mastoideum* of Bojanus, No. 10.

Os extrascapulare. Stannius.

Os mastoideum. Stannius.

Schuppentheil des Schläfbeins. Köstlin.

¹Prior to the appearance of his *Anatomy of Vertebrate Animals*, in 1871, Huxley homologized this bone with the *squamosal* of the higher vertebrates; later he accepted Parker's interpretation.

²From Erdl's plate and description I cannot be certain as to the identity of this bone. Owen was evidently puzzled over it as I find in his MS. notes the following: "*Appears to be pterotic.* Compared to outer auditory bone in beaver."

- Squama temporis.* Hallmann.
Squamosal. Huxley.
Temporale. Vogt and Yung. Not *temporal* of Geoffroy, No. 5, nor of Cuvier No. 17.
Zitsenbein. Meckel.
10. **Opisthotic.** Parker, Huxley.
Felsenbein. Oken.
Intercalare. Segemehl.
In-rupéal. Geoffroy.
Mastoideum. Bojanus, Köstlin. Not *mastoid* of Owen, No. 9.
Oberflächliche Knochen-lamelle. Stannius.
Os innominatum. Hallmann.¹
Otosteal. Owen.
Petrosal. Owen. Not *petrosal* of Segemehl, No. 15.
Rocher. Cuvier.
Rocher rudimentaire. Agassiz.
11. **Exoccipital.** Owen, Günther, Parker. Not *exoccipital* of Geoffroy, No. 7.
Gelenktheil. Meckel.
Gelenktheil des hinterhauptbeins, condyloidea ossis occipitis. Erdl.
Occipital latéral. Cuvier, Agassiz.
Os occipitale laterale. Stannius, Vogt and Yung.
Suroccipital. Geoffroy.
Seitlichen untern Hinterhauptbeine. Meckel, Wagner.
12. **Basioccipital.** Owen, Parker, Günther.
Basilaire. Cuvier, Agassiz.
Basiltheil des hinterhauptbeins basilaris ossis occipitis. Erdl.
Basisphénal. Geoffroy.
Corpus ossis occipitis. Hallmann.
Hinterhauptbeinkörper. Wagner.
Os basillare. Stannius.
Otosphénal. Geoffroy.
13. **Parasphenoid.**² Huxley, Parker.
Basisphenoid (the posterior half). Owen,³ Günther. Not *basisphenoid* of Huxley, No. 14.

¹ Hallmann has also used this term for *basisphenoid* No. 14.

² "The bones of fish and amphibians usually denominated *vomers* must part with their claims to that title and yield it to the so-called *parasphenoid*." Sutton in Proc. of the Zool. Soc. London, 1884, p. 570.

³ Owen and Cuvier give the opposite ends of the *parasphenoid* different names.

Corpus ossis sphenoides. Erdl.

Hyposphénal. Geoffroy.

Keilbeinkörper. Meckel, Wagner, Erdl.

Os sphenoidum basilare. Stannius.

Progressus ascendens piscium. Hallmann.

Presphenoid (the anterior half). Owen.

Sphénoïde principal. Agassiz.

Sphenoidum basilare. Hallmann.

Sphénoïde postérieur (the posterior half) }
Sphénoïde principale (the anterior half) } Cuvier.

14. **Basisphenoid**. Huxley. Not *basisphenoid* of Owen, No. 13.

Entosphénal. Geoffroy.

Ala parva sphenoides (in carp). Hallmann.

Dichost. Gill.

Ethmoid. Owen. Not *ethmoid* of Parker, No. 3; nor Cuvier, No. 2; nor *Ethmoideum* of Vogt and Yung, No. 16.

Ethmo-turbinal. Owen.

Ethmoïde crânién. Agassiz.

Os sphenoidum anterius. Stannius.

Os innominatum (in perch). Hallmann.

Sphénoïde antérieur. Cuvier.

15. **Prootic**. Parker.

Alisphenoid. Owen, Günther. Not *alisphenoid* of Huxley, No. 16.

Ala temporalis. Stannius.

Felsenbein. Meckel, Wagner.

Felsenheil des Schläfenbeines, petrosa. Erdl.

Grande aile du sphénoïde. Cuvier, Agassiz.

Hinterer Schläfenflügel. Köstlin.

Petrosum. Hallmann.

Petrosal. Segemehl. Not *petrosal* of Owen, No. 10.

Ptéreal. Geoffroy.

Prooticum. Huxley.

16. **Alisphenoid**. Huxley, Parker. Not *alisphenoid* of Owen, No. 15.

Aile orbitaire. Cuvier, Agassiz.

Ala orbitalis. Stannius.

Ala magna sphenoides. Hallmann.

Ethmoideum. Vogt and Yung. Not *ethmoideum* of Erdl, No. 3; nor of Hallmann, No. 2; nor *ethmoid* of Owen, No. 14.

Grosse Keilbeinflügel. Meckel, Wagner.
Ingrassial. Geoffroy.
Kleine Flügel des Keilbeins. Bojanus.
Kleiner Keilbeinflügel, ala minor ossis sphenoides. Erdl.
Orbitosphenoid. Owen.
Subtectals. Gill.
Vordere Schläfenflügel. Köstlin.

17. **Hyomandibular.** Huxley, Parker, Günther.
Epitympanic. Owen.
Gelenktheil des Schläfensbeins. Köstlin.
Mastöidien. Agassiz.
Obere Gelenkbein. Meckel, Wagner.
Os quadratum S. tympanicum. Hallmann.
Os temporale. Stannius.
Paukering-knochen. Bojanus.
Schuppentheil des Schläfensbeines, squamosa ossis temporum. Erdl.
Serrial. Geoffroy.
Temporal. Cuvier. Not *temporal* of Vogt and Yung, No. 9; nor of Geoffroy, No. 5.
18. **Symplectic.** Parker.
Griffelförmig Knoche. Meckel.
Mesotympanic. Owen.
Os symplecticum. Stannius, Hallmann.
Symplectique. Cuvier.
Tympano-malléal. Agassiz.
- 19. **Quadrate.** Huxley, Parker, Günther.
Flügelbein. Bojanus.
Hypocotyléal. Geoffroy.
Hypotympanic. Owen.
Jochfortsatz. Köstlin.
Jugal. Cuvier. Not *jugal* of Agassiz, No. 50.
Os quadratum. Agassiz.
Os carré. Agassiz.
Os quadratojugale. Stannius, Hallmann.
Unter Gelenkbein. Meckel, Wagner.
Vorderes Stück des os quadratum. Erdl.
20. **Pterygoid.** Owen, Parker, Günther.
Adgustal. Geoffroy.

Ectopterygoid. Huxley.

Externum. Stannius.

*Gaumenbein*¹ *os palatinum*. Erdl. Not *gaumenbein* of Meckel, No. 21; nor *palatinum* of Stannius, No. 21.

Keilbeinflügel. Köstlin.

Os transversum s. pterygoideum externum. Stannius.

Pterygoideum externum. Hallmann.

Transverse. Cuvier, Agassiz.

21. Palatine. Owen, Parker.

Gaumenbein. Meckel. Not *Gaumenbein* of Erdl, No. 20.

Os palatinum. Stannius.

Palatin. Cuvier, Agassiz, Günther, Geoffroy.

22. Mesopterygoid. Parker.

Entopterygoid. Owen, Günther, Huxley.

Ergänzungsstück oder Flügelfortsatz, os pterygoideum. Erdl.

Herisséal. Geoffroy.

Os pterygoideum. Stannius.

Os transversum. Köstlin.

Pterygoidien interne. Cuvier, Agassiz.

Pterygoideum internum. Hallmann.

Untere Keilbeinflügel. Meckel.

23. Metapterygoid. Huxley, Parker, Günther.

Caisse. Agassiz.

Epicotyléal. Geoffroy.

Gaumenflügel des Keilbein. Bojanus.

*Hintere*² *Stück des os quadratum*. Erdl.

Os tympanicum. Stannius.

Os tympani. Agassiz.

Pterygoideum posterius. Hallmann.

Pretympanic. Owen.

Scheibenförmig Knoche. Meckel, Wagner.

Tympanal. Cuvier. Not *tympanal* of Geoffroy, No. 24.

¹ Only one element is shown in Erdl's plate where the palatine and pterygoid usually are. Its articulation below is typical for the pterygoid, while above it is described as being attached to the vomer. Either the palatine is missing or the suture between it and the pterygoid has been overlooked. Erdl uses the same names as Meckel and Stannius for the palatine. In his MS. notes Owen has identified it as the pterygoid and it is here so inserted.

² In his MS. notes Owens refers this to the *symplectic (mesotympanic)*. The shape, size and position of the bone in Erdl's plate would seem clearly to indicate the *metapterygoid*.

24. **Preopercle.**
Preopercular.
Preoperculum. } General English usage.
Apophyse styloïde du temporal. Agassiz.
Pré-opercule. Cuvier.
Tympanal. Geoffroy. Not *tympanal* of Cuvier, No. 23.
Vorderdeckel. General German usage.
Vorkiemendeckelstück. Meckel.
25. **Opercle.**
Opercular.
Operculum. } General English usage.
Engentlich Kiemendeckelstück. Meckel, Wagner.
Kiemendeckel. Erdl.
Opérculaire. Cuvier, Agassiz.
Stapéal. Geoffroy.
26. **Subopercle.**
Subopercular.
Suboperculum. } General English usage.
Incéal. Geoffroy.
Sous-opercule. Cuvier, Agassiz.
Unterkiemendeckelstück. Meckel, Erdl.
Unterdeckel. General German usage.
27. **Interopercle.**
Interopercular.
Interoperculum. } General English usage.
Inter-opercule. Cuvier, Agassiz.
Malléal. Geoffroy.
Zwischendeckel. General German usage.
Zwischenkiemendeckelstück. Meckel, Erdl.
28. **Articular.** Owen, Parker.
Articulaire. Cuvier, Agassiz.
Articulary. Günther.
Ast des Unterkiefers, ramus mandibulæ. Erdl.
Gelenkstück des Unterkiefers. Meckel.
Os articulaire. Stannius, Hallmann.
Os condyloïdeum. Franque.
Submalleal. Geoffroy.
29. **Angular.** Owen, Günther, Parker.
Angulaire. Cuvier, Agassiz.

Os angulare. Stannius.

Sub-cotyléal. Geoffroy.

30. Dentary. Owen and most modern authors.

Dentaire. Cuvier, Agassiz.

Körper des Unterkiefers, corpus mandibulæ. Erdl.

Os dentale. Stannius, Hallmann.

Subdental. Geoffroy.

Zahnstück des Unterkiefers. Meckel.

31. Maxillary. Owen, Parker and in general English use.

Addental. Geoffroy.

Maxilla superior. Hallmann, Erdl.

Maxillaire supérieur. Cuvier, Agassiz.

Os maxillare. Stannius.

Oberkieferbein. Meckel, Wagner, Erdl.

32. Premaxillary. Owen, Parker.

Adnasal. Geoffroy.

Intermaxillines. Gill.

Intermaxillary. Owen.

Intermaxillaire. Cuvier, Agassiz.

Os intermaxillare. Stannius.

Zwischenkieferbein. Meckel, Wagner and most modern German authors.

Zwischenkiefer, os incisivum. Erdl.

33. Interhyal. Parker, Gill.

Griffelforsatz des Schlafensbein. Meckel, Wagner.

*Griffelbein.*¹ Vogt and Yung.

Os styloideum. Stannius.

Styloïde de l'os hyoïde. Agassiz.

Styloïde. Cuvier.

Stylohyal. Owen, Günther, Geoffroy.

34. Epihyal. (Not differentiated by name from No. 35.) Owen, Günther, Parker.

Abgeplattetes Stück des Zungenbogen. (Not differentiated by name from No. 35.) Vogt and Yung.

Branche laterale. (Not differentiated by name from No. 35 Agassiz.

Grande pièce latérale. Cuvier.

¹ Vogt and Yung give this term also to the *inferior post clavicle* No. 56.

Hinteres Stück des grossen Zungenbeinhornes, ossis hyoidei.
Erdl.

Hyo-sternal. Geoffroy.

Zungen-horn oder Zungen-bogen. (Not differentiated by name from No. 35.) Meckel.

35. **Ceratohyal.** Owen, Günther, Parker. Not *ceratohyal* of Geoffroy, No. 36.

Abgeplattetes Stück des Zungenbogens. (Not differentiated by name from No. 34.) Vogt and Yung.

Branche laterale. (Not differentiated by name from No. 34.) Agassiz.

Grande pièce latérale. (Not differentiated by name from No. 34.) Cuvier.

Hyposternal. Geoffroy.

Zungen-horn oder Zungen-bogen. (Not differentiated by name from No. 34.) Meckel.

Vorderes Stück des grossen Zungenbeinhornes, Cornu majus.
Erdl.

36. **Basihyals.** Owen, Günther, Parker. Not *basihyals* of Geoffroy, No. 40.

Apohyal. Geoffroy.

Ceratohyal. Geoffroy. Not *ceratohyal* of Owen, No. 35.

Gelenkstück des Zungenbogens. Vogt and Yung.

Kleines Zungenbeinhorn, Cornu minus ossis hyoidei. Erdl.

Petite pièce laterale. Cuvier.

Tête glenoidale. Agassiz.

37. **Glossohyal.** Owen, Günther. Not *glossohyal* of Geoffroy, No. 39.

Côtes sternales. Geoffroy. Not *côtes sternales* of Cuvier, No. 69.

Entoglossum. Vogt and Yung.

Os lingual. Cuvier.

Os lingual s. entoglossum. Stannius.

38. **Urohyal.** Owen, Günther, Parker. Not *urohyal* of Hallmann, No. 40.

Basibranchiostegal. Parker.

Corps de l'hyoïde. Agassiz.

Episternal. Geoffroy.

Queue de l'os hyoïde. Cuvier.

Zungenbein. Meckel.

39. **Branchiostegal.** Owen, Günther, Parker.
Glosso-hyal. Geoffroy. Not *glossohyal* of Owen, No. 37.
Kiemenhautstrahlen. Meckel.
Kiemenstrahlen. Erdl.
Rayons branchiostèges. Cuvier, Agassiz.
Radii branchiostegi. Stannius.
40. **Basibranchials.** Owen, Günther, Parker.
Axial branchihyals. Cope.
Basi-hyal. Geoffroy. Not *basihyal* of Owen, No. 36.
Chaîne intermédiaire d'osselets. Cuvier.
Copula. Stannius, Vogt and Yung.
Ento-hyal. Hallmann.
Queue de l'os hyoïde. Agassiz.
Uro-hyal. Hallmann. Not *urohyal* of Owen, No. 38.

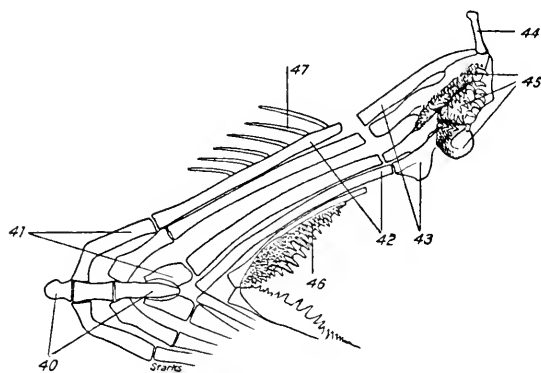


FIG. 45. *Roccus lineatus*. Branchial arches.

41. **Hypobranchials.** Owen, Günther, Parker.
Basal branchihyals. Cope.
Kiemenbogen. Meckel.
Pièce articulaire. Agassiz.
Pièce interne de partie inférieure de l'arceau branchiale
 Cuvier.
Thyréal. Geoffroy.
Unteres Stück des Kiemenbogens. Vogt and Yung.
42. **Ceratobranchials.** Owen, Günther, Parker.
Lateral branchihyals. Cope.
Mittleres Stück des Kiemenbogens. Vogt and Yund.
Pièce branchiale. (Not differentiated by name from No. 43.)
 Agassiz.

Pièce externe de la partie inférieure de l'arceau branchiale.

Cuvier.

Pluréal inférieure. Geoffroy.

43. Epibranchials. Owen, Parker.

Oberes Stück des Kiemenbogens. Vogt and Yung.

Partie supérieure de l'arceau branchiale. Cuvier.

Pièce branchiale. (Not differentiated by name from No. 42.)

Agassiz.

Pluréal supérieure. Geoffroy.

Superior branchials. Vogt and Yung.

44. Suspensory pharyngeal. Starks.

Stilet de première arceau branchiale. Cuvier.

Upper epibranchial of first branchial arch. Owen.

Verbindungstück. Vogt and Yung.

45. Upper or Superior pharyngeals. Parker, Günther, Geoffroy, Cope.

Epipharyngeals. Gill.

Obere Schlundknochen. Meckel, Vogt and Yung.

Os pharyngien supérieur. Agassiz.

Os pharyngeum superius. Stannius.

Pharyngo-branchial. Owen.

46. Lower or Inferior pharyngeals. Owen, Günther, Parker.

Cerato-branchial of fifth arch. Owen.

Hypopharyngeals. Gill.

Infrapharyngeals. Cope.

Ossa pharyngea inferiora. Stannius.

Pharyngiens inférieurs. Cuvier.

Pharyngeal arch. Owen.

Untere Schlundknochen. Vogt and Yung.

47. Gill-rakers. In general English use.

Kiemenstechel. In general German use.

48. Supraorbital.¹ Owen.

Sur-orbitaire. Cuvier, Agassiz.

Oberaugenhöhlenbein. Meckel.

Oberaugenbein. In German use.

49. Preorbital. Gill.

Adorbital. Geoffroy.

¹This element not occurring in the species here figured it seems useless to make a separate drawing from another species as the term is self-explanatory.

- Antorbital.* Franque.
Lachrymal. Owen, Cuvier, Parker. Not *lachrymal* of Geoffroy, No. 3.
Thränenbein. Meckel.
50. **Suborbitals.** Owen.
Augenring, ossa orbitalia (Os zygomaticum). Erdl.
Infraorbitalring. Owen.
Jochbein. Meckel.
Jugal. Agassiz, Geoffroy. Not *jugal* of Cuvier, No. 19.
Ossa infraorbitilia. Stannius.
Ossa jugalia. Bojanus.
Sous-orbitaires. Cuvier.
Unteraugenhöhlenbein. Wagner.
51. **Nasal.** Cuvier, Parker, Gill. Not *nasal* of Owen, No. 2.
Cartilage mobile du nez. Agassiz.
Ethmophysal. Geoffroy.
Nasenbein. Meckel, Erdl.
Os nasi. Erdl.
Os terminale. Stannius.
Turbinal. Owen, Günther.
52. **Supra-temporal.** Owen.
Augenbogenschuppe. Bojanus.
Sur-temporal. Cuvier.
Supralinear. Shufeldt.
53. **Posttemporal.** Parker, Günther, Gill.
Oberes Schulterblatt, scapula superior. Erdl.
Omolite. Geoffroy.
Schulterblatt. (Not differentiated by name from No. 54.) Meckel.
Scapulare. Vogt and Yung. Not *scapula* of Owen, No. 54; nor of Parker, No. 57.
Supracleithra. (Not differentiated by name from No. 54.) Gegenbaur.
Suprascapula. Owen.
54. **Supraclavicle.** Parker.
Coracoideum. Vogt and Yung. Not *coracoid* of Owen, No. 55; nor of Agassiz, No. 56; nor of Parker, No. 58.
Omoplate. Geoffroy.
Posterotemporal. Gill.

Scapula. Owen, Stannius. Not *scapulare* of Vogt and Yung, No. 53; nor *scapula* of Parker, No. 57.

Scapulaire. Cuvier, Agassiz.

Supraclavicula. Parker, Günther.

Schulterblatt (not differentiated by name from No. 53). Meckel.

Supraclithra (not differentiated by name from No. 53). Gegenbaur.

Unteres Schulterblatt, scapula inferior. Erdl.

55. Clavicle. Parker.

Clavicula. Stannius, Parker, Günther.

Clavicula anterior. Erdl.

Cleithrum. Gegenbaur.

Cænosteon.¹

Coracoid. Owen. Not *coracoid* of Agassiz, No. 56; nor of Parker, No. 58; nor *coracoideum* of Vogt and Yung, No. 54.

Huméral. Cuvier. Not *huméral* of Agassiz, No. 59; nor

Humérus of Geoffroy, No. 58; nor of Erdl, No. 56.

Proscapula. Gill.

Vordere Schlüsselbein. Meckel, Erdl.

Vordere clavícula. Erdl.

56. Postclavicle. Parker.

Accessorisches Stück. Gegenbaur.

Basal superius (the upper one). Vogt and Yung.

Coracoid. Agassiz. Not *coracoid* of Owen, No. 55; nor of Parker, No. 58; nor *Coracoideum* of Vogt and Yung, No. 54.

Epicoracoid. Owen.

*Griffelbein*² (the lower one). Vogt and Yung.

Hintere Schlüsselbein. Meckel.

Humerus. Erdl. Not *humérus* of Geoffroy, No. 58; nor of Owen, No. 59; nor *huméral* of Cuvier, No. 55.

Oberarmbein. Erdl.

Os coracoïdien. Cuvier.

Postclavicula. Parker, Günther.

Problematischer Skelettheil. Gegenbaur.

Teleotemporals. Gill.

57. Hypercoracoid. Gill.

Basale medium. Vogt and Yung.

¹I get this reference from Owen's Comp. Anat. Lectures (Vertebrates), p. 118. "By some Ichthyotomists the bone in question has received the special name of 'cænosteon.'"

²Vogt and Yung also give this term to the *interhyal* (No. 33).

Oberes Stück (scapulare). Gegenbaur.

Ossa carpi (not differentiated by name from No. 58). Stannius.

Radial. Cuvier, Agassiz. Not *radius* of Owen, No. 58; nor of Geoffroy, No. 60.

Scapula. Parker. Not *scapula* of Owen, No. 54; nor *scapulare* of Vogt and Yung, No. 53.

Ulna. Owen.

Vorderarmknochen (not differentiated by name from No. 58). Meckel.

Vorderarmbein,¹ *antibrachium*. Erdl.

58. Hypocoracoid. Gill.

Basale inferius. Vogt and Yung.

Coracoid. Parker, Günther. Not *coracoid* of Owen, No. 55; nor of Agassiz, No. 56; nor *coracoideum* of Vogt and Yung, No. 54.

Cubital. Cuvier, Agassiz. Not *cubitus* of Geoffroy, No. 60.

Hinteres Schlüsselbein, clavicula posterior. Erdl. Not *hintere Schlüsselbein* of Meckel, No. 56.

Humérus. Geoffroy. Not *humerus* of Owen, No. 59; nor *huméral* of Cuvier, No. 55.

Ossa carpi (not differentiated by name from No. 57). Stannius.

Radius. Owen. Not *radius* of Geoffroy, No. 60; nor *radial* of Cuvier, No. 57.

Vorderarmknochen (not differentiated by name from No. 57). Meckel.

Vorderes stück (Procoracoid). Gegenbaur.

59. Mesocoracoid. Gill.

Humerus. Owen. Not *humérus* of Geoffroy, No. 58; nor of Erdl, No. 56.

Humeral. Agassiz. Not *huméral* of Cuvier, No. 55.

Precoracoid. Parker.

Spangenstein. Gegenbaur.

Troisième os de l'avant bras qui porte la nageoire pectorale. Cuvier.

60. Actinosts. Gill.

Branchial ossicles. Parker.

Basalia. Huxley, Günther.

Basalstücke der Brustflösse. Gegenbaur.

¹ "Durch ein Loch in ihm ist die Abtheilung in eine grössere und kleinere Portion—ulna und radius—angedeutet." Erdl.

Basal pectoral radii. Cope.

Carpals. Owen, Günther.

Carpus. Vogt and Yung.

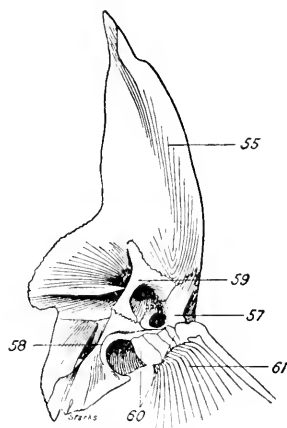


FIG. 46. *Ictiobus bubalus*. Inner view of shoulder girdle.

Carpe and Metacarpe. Agassiz.

Mittelhandknochen, metacarpus. Ertl.

Os du carpe. Cuvier.

Ossa metacarpi. Stannius.

Radius and cubitus. Geoffroy. Not *radius* of Owen, No. 58; nor *radial* of Cuvier, No. 57; nor *cubital* of Cuvier, No. 58.

61. Pectoral rays. In general English use.

Brustflossenstrahlen. Stannius.

Carpe and Phalanges. Geoffroy.

Metacarpophalanges. Owen.

Rayons de la pectorale. Cuvier.

62. Pelvic girdle. In general use.

Becken. Stannius.

Pubic cones. Owen.

63. Ventral spine. In general use.

Bauchflossen Stachel. Stannius.

64. Abdominal vertebræ. Owen and in general use.

Bauchwirbel. Stannius.

Vertèbres abdominales. Cuvier.

65. **Caudal vertebræ.** Owen and in general English use.
Schwanzwirbel. Stannius.
Vertèbres caudales. Cuvier.
66. **Centrum.** In general use.
Corps de vertèbre. Cuvier.
Cycléal. Geoffroy.
Cyclo-vertebral element. Grant.
Tertiär-wirbel. Carus.
Wirbel-körper. Müller, Wagner.
67. **Neurapophyses.** Owen.
Bogenstücke des Rückenwirbels. Carus.
Deckplatten. Carus.
Grundplatten. Carus.
Obere Wirbelbogen. Wagner.
Neural process or neural arch. Parker.
Parte annulaire. Cuvier.
Perial. Geoffroy.
Peri-vertebral elements. Grant.
68. **Neural spine.** Owen, Parker.
Apophyse épineuse. Cuvier.
Épial. Geoffroy.
Epi-vertebral elements. Grant.
Oberer Dorn-forsatz. Carus.
69. **Hæmapophyses.** Owen, Vogt and Yung.
Bogenstücke des Bauchwirbel. Carus.
*Cata-vertebral elements.*¹ Grant.
Cataal. Geoffroy.
Côtes sternales. Cuvier. Not *côtes sternales* of Geoffroy, No 37.
Hæmal processes or hæmal arch. Parker.
Unter-sternal-theil des Urwirbelbogens. Carus.
70. **Hæmal spine.** Owen, Parker.
Sternal Wirbel Körper. Carus.
Unterer Dorn-forsatz. Carus.
Untere Bogen. Gegenbaur.
71. **Zygapophyses.** Owen, Parker.
Aphophyse articulaire. Cuvier.
Gelenk-forsatz. Müller, Wagner.

¹ Used also for *ribs*, No. 73, by Grant.

Schiefer Forsatz. Vogt and Yung.

Seitlicher Tertiar-wirbel. Carus.

72. Parapophyses. Owen, Gill.

Apophyse transverse. Cuvier.

*Hæmapophyse.*¹ Vogt and Yung.

Paraal (also used for *rib* by this author). Geoffroy.

Para-vertebral elements. Grant.

Querforsatz. Carus.

Rippe Gelenkstück. Erdl.

Transverse process. Parker.

Untere quersatz. Wagner.

73. Rib. In general use.

Cata-vertebral elements (used also for *hæmapophyses*, No. 69, by this author). Grant.

Costal process. Owen.

Côtes vertébrales. Cuvier.

Pleurals. Gill.

Paraal. Geoffroy.

Pleurapophyses. Owen.

Rippen. Stannius.

Rückenthail und Ober-sternal-theil des Urwirbelbogens. Carus.

74. Epipleural spines or Epipleurals. Owen, Gill, Günther.

Intermusculars. Parker.

Muskel-Gräthen. Stannius.

Stylets. Cuvier.

75. Interneural spines or Interneurals. Owen, Parker.

Flossen-träger. Stannius.

Flossenstrahlträger. Gegenbaur.

Innere Flossenstrahl. Erdl.

Interépineux. Cuvier.

Obere-rippe. Meckel.

Ossa interspinalia s. obere Flossen-träger. Stannius.

76. Dorsal rays and spines. In general English use.

Dermoneural spines. Owen.

Épines et rayons dorsales. Cuvier.

Rücken-flossen strahlen und stecheln. Stannius.

¹ Vogt and Yung do not differentiate by name the inferior processes of the abdominal vertebræ (*parapophyses*) from those of the caudal vertebræ (*hæmapophyses*).

Weichstrahlen und Stechelstrahlen der Rückenflosse. Gegenbaur.

77. **Interhæmal spines or Interhæmals.** In general English use.

Apophyses épineuses inférieures. Cuvier.

Unterflossen träger. Stannius.

78. **Anal rays and spines.** In general use.

Weichstrahlen und Stechelstrahlen des Afterflosse. Gegenbaur.

79. **Hypural.** Huxley, Parker, Günther.

Aggregated interhæmals. Owen.

Plaque triangulaire et verticale. Cuvier.

Verticale Platte. Stannius.

80. **Caudal-rays.** In general English use.

Schwanzflossen Strahlen. Stannius.

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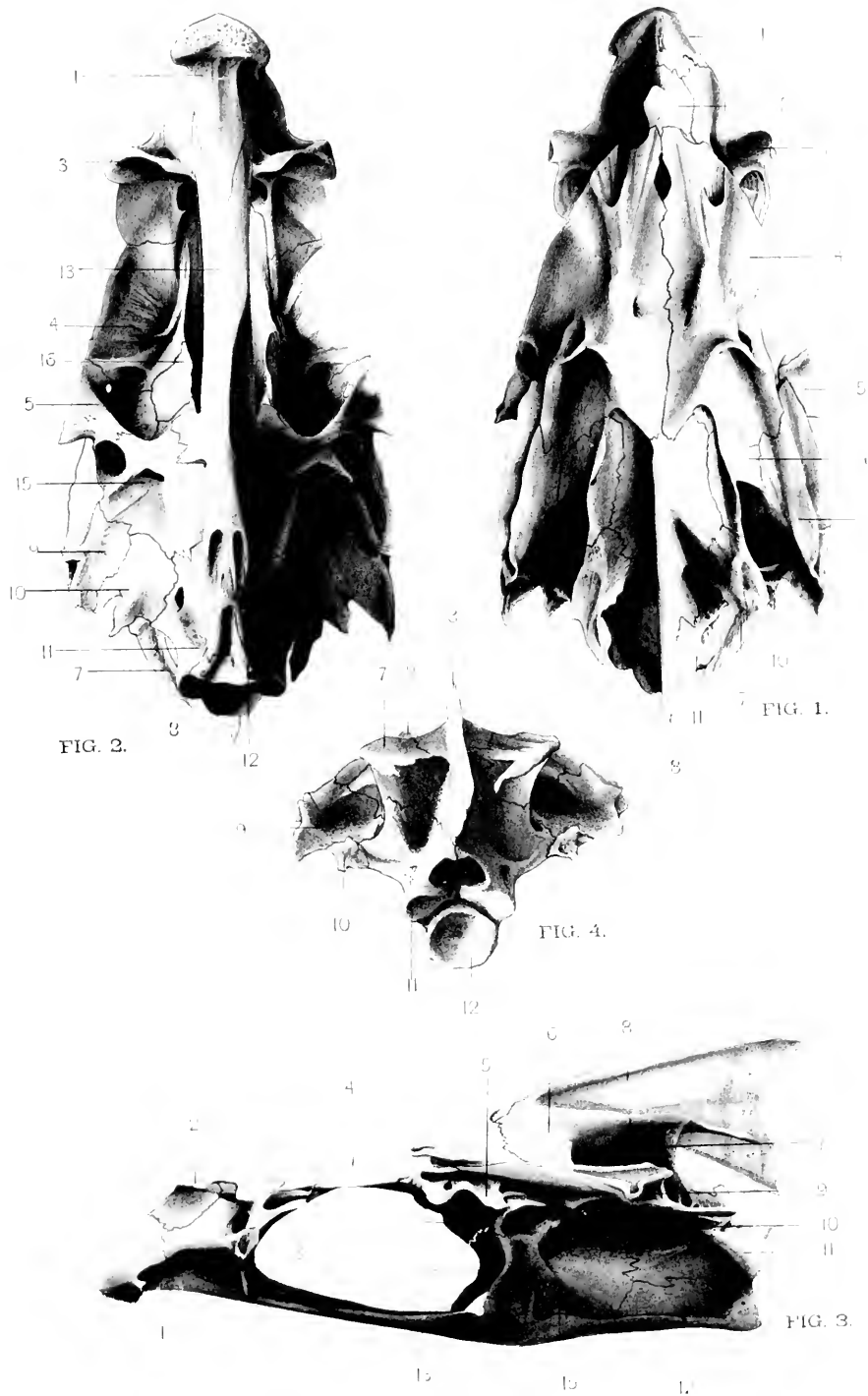
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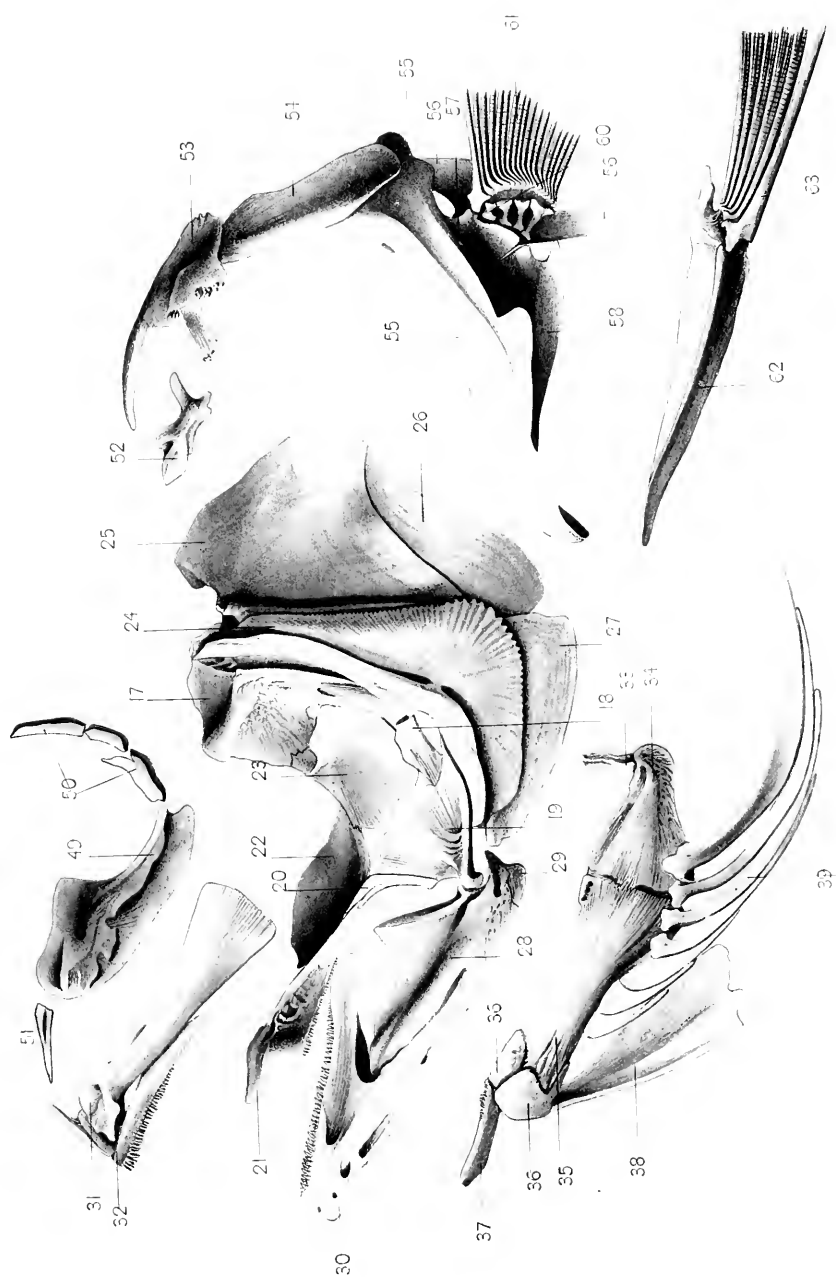


CRANIUM OF *ROCCUS LINEATUS*.

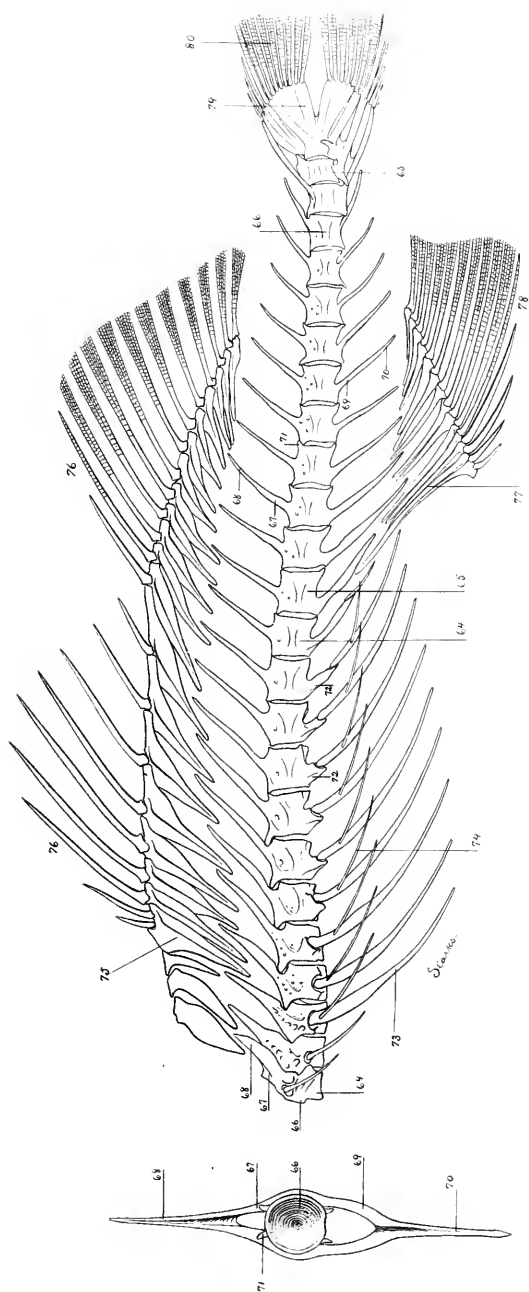
FIG. 1. TOP VIEW
 FIG. 2. BOTTOM VIEW

FIG. 3. SIDE VIEW
 FIG. 4. END VIEW





ROCCUS LINEATUS. FACE BONES, SHOULDER GIRDLE, PELVIC GIRDLE, AND HYOID ARCH.



ROCCUS LINEATUS VERTEBRAL COLUMN AND APPENDAGES, WITH A TYPICAL VERTEBRA.

PROCEEDINGS
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PAPERS FROM THE HOPKINS STANFORD GALA-
PAGOS EXPEDITION, 1898-1899.

V.

ENTOMOLOGICAL RESULTS (5):

THYSANURA AND TERMITIDÆ.

BY NATHAN BANKS,

U. S. NATIONAL MUSEUM.

Two species of *Thysanura* were collected on the Galapagos Islands, and one, in considerable numbers, on Clipperton Island. All appear to be new, but belong to genera of world-wide distribution. One of the species from the Galapagos Islands is of very large size. The species from Clipperton Island is interesting on account of lacking a curious character present in many, if not all, of the other species of the genus. The Collembola do not appear to have been collected, although doubtless fairly abundant on the islands.

Family LEPISMIDÆ.

LEPISMA GALAPAGOENSIS sp. nov.

Length 20 mm., width of prothorax 5 mm. Body above and below covered with dark steel blue scales; antennæ and cerci annulate; legs pale, yellowish on tarsi. Body of usual shape and

appearance. Head broad, with 14 tufts of hair seen from above as follows: one in front of each eye, one behind each antenna, two above base of each antenna, one in front of each antenna, and two each side on anterior margin; below on clypeus there are other

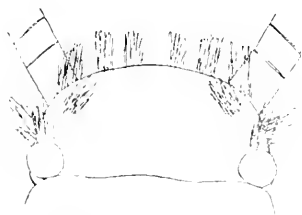


FIG. 47. *Lepisma galapagoensis*, head.

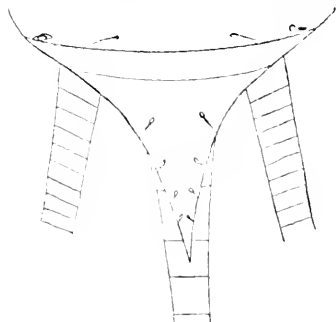


FIG. 48. *Lepisma galapagoensis*, tail.



FIG. 49. *Lepisma galapagoensis*, maxillary palp.



FIG. 50. *Lepisma galapagoensis*, labial palp.

tufts. Maxillary palpi with intermediate joint longest, penultimate nearly twice as long as the last. Labial palpi with last joint foot-shaped. The antennæ are much longer than the body, the cerci about length of body; telson slender and acutely pointed over base of median cercus. Legs with many hairs and spine-like bristles. Thorax with spine-like bristles along sides. On the meso- and metathorax there are on each side margin five roundish groups of yellowish pores, on the hind margin about half way from middle to side is an oblique row of them, and there is a roundish group nearer to side. On the posterior margin of each abdominal segment are two oblique rows of pores, one near edge of body, the other about one-third way from edge to median line; these rows have their inner ends more forward than the outer ends. On each ventral segment there are each side two tufts of yellowish hairs or bristles, besides the appendage.

Several specimens from Hood Island in May. The largest species known to me.

LEPISMA INSULARIS sp. nov.

Length 7 mm., width of prothorax 1.4 mm. Body with light brownish scales, some specimens show the abdomen more or less banded; legs pale, with many hairs; antennæ and cerci pale, but more or less distinctly annulate with dark. Head more conical than preceding species; there is a crest of hairs over base of each antenna, and a few scattered groups on anterior margin. The maxillary palpi have the last joint a little longer than preceding joint, the intermediate joint a little longer than any of the others. The labial palpi have the last joint obscurely triangular. The antennæ are about the length of the body, and the cerci are plainly shorter than body. The telson is broadly triangular and rounded at tip. The legs have the usual stout spur at upper tip of each tibia. There are no distinct groups of pores on the thoracic segments, but on the abdominal ones there is on each side near the edge of body an oblique row of three pores.

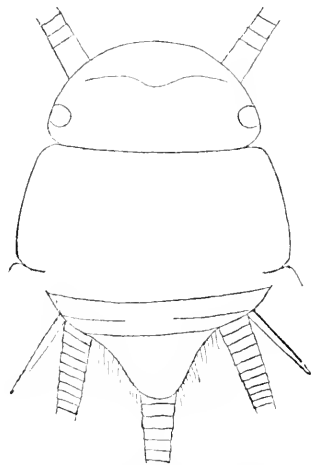


FIG. 51. *Lepisma insularis*, head and tail.



FIG. 52. *Lepisma insularis*, maxillary palp.

Several specimens from Narboro Island and one from Tagus Cove, Albemarle Island, all in January.

Family MACHILIDÆ.

MACHILIS MUTICA sp. nov.

Length when extended 7 mm. Body clothed above with dark scales, some paler patches on the thorax; pale beneath; legs and palpi pale; antennæ annulate; cerci dark above, pale beneath; abdominal appendages pale. Body curved, the head bent down. Eyes united for only a short distance, below each eye is a white hour-glass figure, the anterior end rather larger but shorter than posterior end. Between

the bases of antennæ is a median brown spot. The last joint of maxillary palpi is plainly shorter than the penultimate, which is about equal to the one preceding it; the basal joints are marked above with

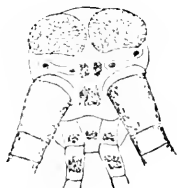


FIG. 53. *Machilis mutica*, head.

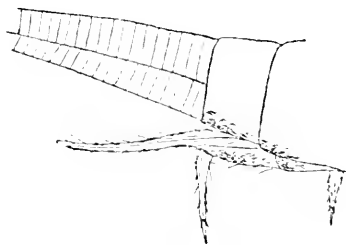


FIG. 54. *Machilis mutica*, end of body.

brown. Antennæ once and one-half length of body: the basal joint about twice as long as wide; beyond the joints are of the usual curious arrangement; first several hard dark rings alternate with pale, then three dark rings in a group, then four, then six, then eight, then ten or twelve, and keeping at about ten to sixteen to the tip. Median cercus as long as body, lateral cerci less than one-third the length of the median. There does not appear to be any trace of the appendages to the second and third coxæ, found in other species.

A number of specimens from Clipperton Island in November.

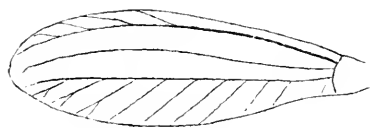
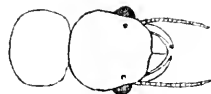
Family TERMITIDÆ.

Of the two species of Termites collected both appear to be distinct from any previously described. When the species from the Central American region are more full known it may be found that they also occur there. The genus *Calotermes* is found throughout tropical countries.

CALOTERMES GALAPAGOENSIS sp. nov.

Length, with wings, 9.5 mm.; body 5 mm.

Yellowish brown; mouthparts, antennæ, legs and ventral region paler; wings nearly hyaline, subcostal vein and its branches brown, costal area slightly infusate. Head quite broad, eye situate before the middle, ocelli present. Prothorax much broader than long, scarcely narrower than the head, rounded behind, with a median pale line above. Abdomen nearly as long as head and thorax together. Wings much longer than body, quite broad, pointed at tip; the sub-

FIG. 55. *Calotermes galapagoensis*, wing.FIG. 56. *Calotermes galapagoensis*, head and pronotum.

costal vein does not branch till beyond the middle of wing, median vein about half-way between the subcostal and submedian with the usual branches simple, except those near the apex which are forked.

Several specimens from Wenman Island in December.

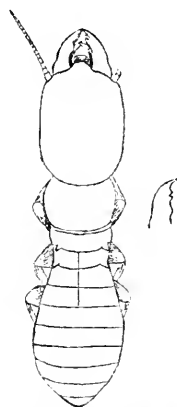
CALOTERMES PACIFICUS sp. nov.

Length, with wings, 11 mm.; body 8 mm.

Pale yellowish brown; beneath paler, as also on legs and antennæ; wings hyaline, costal and subcostal veins with the branches brown. Head not very large, eyes at about middle, ocelli present. Prothorax nearly twice as broad as long, concave in front, fully as broad as head. Meso- and metathorax much longer than prothorax, and fully as broad. Abdomen plainly longer than head and thorax together. Wings not greatly longer than the body, moderately broad, branches before middle and before end of costal, the median vein is about half-way between the subcostal and submedian veins, branched near the tip and connected to subcostal, the submedian has most of its apical branches forked, those toward base are very oblique.

Soldier—Length 12 mm.

Head castaneous, darker in front than behind; mandibles black; rest of body, legs and antennæ pale yellowish. Head about once and one-third longer than broad, sides slightly convex, equally broad in front and behind, somewhat flattened above, near anterior margin slightly concave above the middle. Mandibles stout and large, with two small teeth toward tip and a larger one basad, on outer side at base there is a hump. Antennæ slender, about as long as width of the head, 14-jointed, the third joint plainly longer than any of the others, also darker. Prothorax plainly broader than long, fully as large as meso- and metathorax together, the latter but slightly sepa-

FIG. 57. *Calotermes pacificus*, soldier and mandible.

rated from each other, and each with a small projection or tubercle near each posterior outer corner; abdomen short, in the middle a little broader than the head.

A number of specimens from Albemarle Island in December and February, and from Narboro Island in January. Some soldiers are plainly smaller than others and have their heads a trifle shorter.

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NOVEMBER 29, 1901.

DESCRIPTIONS OF 23 NEW HARVEST MICE
(GENUS REITHRODONTOMYS).

BY C. HART MERRIAM.

THE mammal collection of the Biological Survey contains a large number of specimens of the so-called harvest mice, genus *Reithrodontomys*. Among these are many not heretofore known to naturalists. Twenty-three of these are here described, as follows:

REITHRODONTOMYS TENUIROSTRIS sp. nov.

Type from Todos Santos, Guatemala (altitude 10,000 ft.). No. 76919. ♂ ad. U. S. National Museum, Biological Survey Coll. Dec. 29, 1895. E. W. Nelson and E. A. Goldman. Orig. no. 8917.

Characters.—Size large; tail and ears long and dark; fore feet very large; fur long, soft and full; color intense fulvous.

Color.—Upperparts rich deep fulvous, becoming intense ferruginous on posterior part of back and rump, somewhat more yellowish anteriorly; palest on top of head; underparts salmon fulvous; chin and lips much paler, almost whitish; wrists and middle part of fore feet dark brown; outer side of feet and toes white; ankles and hind feet nearly to base of toes, dark brown; toes whitish; tail dark brown or dusky all around; a small dark ring around eye.

Cranial characters.—Braincase inflated, subglobular, abruptly contracted anteriorly at posterior corner of orbits; zygomata squarely spreading anteriorly, their outer sides nearly parallel; rostrum and nasals long and slender, slightly upturned from plane of frontals; nasals acute posteriorly, ending on plane of premaxillæ; incisive for

amina long and rather slender; bullæ small, set very obliquely to axis of skull; molars rather large.

Measurements.—Type specimen (♂ ad.): total length 210 mm.; tail vertebrae 12.4; hind foot 23.

Skull: basal length 21.5; zygomatic breadth posteriorly 13; length of palate 12.5; length of molar series 4.

REITHRODONTOMYS TENUIROSTRIS AUREUS subsp. nov.

Type from Culel, Guatemala (altitude 10,200 ft.). No. 76939. ♀ ad. U. S. National Museum, Biological Survey Coll. Jan. 15, 1896. E. W. Nelson and E. A. Goldman. Orig. no. 9140.

Characters.—Similar in general to *R. tenuirostris*, but very much paler and yellower; underparts in adult purer fulvous (less of the salmon tinge); underparts in a young specimen whitish. The skull differs from that of *tenuirostris* in the following particulars: braincase less inflated; nasals narrower posteriorly and ending slightly in front of premaxillæ; zygomata slightly less spreading anteriorly, their sides not parallel; palate shorter; the incisive foramina long and cutting plane of first molars; bullæ less oblique.

Measurements.—Type specimen (♀ ad.): total length 196 mm.; tail vertebrae 11.2; hind foot 22.5.

Skull: basal length 20; zygomatic breadth posteriorly 13; length of palate 11.5; length of molar series 4.5.

REITHRODONTOMYS MICRODON sp. nov.

Type from Todos Santos, Guatemala (altitude 10,000 ft.). No. 76923. ♀ ad. U. S. National Museum, Biological Survey Coll. Dec. 31, 1895. E. W. Nelson and E. A. Goldman. Orig. no. 8977.

Characters.—Size small; tail and ears long, dark, and nearly naked; fur long, soft and full; general appearance almost exactly as in the much larger *R. tenuirostris*, of which externally it is an almost exact miniature.

Color.—Upperparts deep reddish fulvous, most intense on rump, palest on head; sides bright fulvous; underparts salmon fulvous (in young specimens sometimes white); a dark ring around eye; a dark brown spot on wrists; fore feet and toes white; ankles and hind feet dark brown; toes white; tail dark all around, but slightly paler beneath.

Cranial characters.—Skull small, light and papery, with rounded, inflated braincase and rather squarely spreading zygomata; rostrum and nasals slender, nasals ending about on plane of premaxillæ. Com-

pared with *tenuirostris* the skull is about two-thirds as large, the rostrum relatively shorter and less upturned, the teeth very much smaller.

Measurements.—Type specimen (♀ ad.): total length 185 mm.; tail vertebrae 113; hind foot 21.

Skull: basal length 17.5; zygomatic breadth posteriorly 11; length of palate 10; length of molar series 3.

REITHRODONTOMYS MICRODON ALBILABRIS subsp. nov.

Type from Cerro San Felipe, Oaxaca, Mexico (altitude 10,000 ft.).

No. 68393. ♀ ad. U. S. National Museum, Biological Survey Coll. Aug. 25, 1894. E. W. Nelson and E. A. Goldman. Orig. no. 6629.

Characters.—Similar in size and general appearance to *R. microdon*, but very much paler, the upperparts fulvous instead of intense ferruginous; lips, sides of nose, and underparts pure white instead of salmon. The skull differs slightly from that of *microdon*: braincase larger, more inflated; zygomata broader anteriorly; incisive foramina shorter; bullæ less inflated and more flattened on outer side; molars slightly larger and heavier.

Measurements.—Type specimen (♀ ad.): total length 187 mm.; tail vertebrae 117; hind foot 20.

Skull: basal length 17; zygomatic breadth posteriorly 11.5; length of palate 10; length of molar series 3.

REITHRODONTOMYS CHRYSOPSIS TOLUCAE subsp. nov.

Type from north slope of Volcan Toluca, State of Mexico (altitude 11,500 ft.). No. 55895. ♀ ad. U. S. National Museum, Biological Survey Coll. Sept. 10, 1893. E. W. Nelson and E. A. Goldman. Orig. no. 5454.

Characters.—Similar to *chrysopsis*, but top of head and upper parts generally much darker, more profusely and finely mixed with black tipped hairs; sides duller and much less fulvous; tail shorter; underparts whitish, the plumbeous underfur showing through; hind feet brownish to near base of toes. Skull similar to that of *chrysopsis*, but slightly smaller and narrower, with even more slender rostrum, slightly smaller bullæ, and slightly smaller molars. Externally the resemblance to *perotensis* is much closer than to *chrysopsis*, but the skull is quite different from that of *perotensis* and very close to *chrysopsis*.

Measurements.—Type specimen (♀ ad.): total length 180 mm.; tail vertebrae 98; hind foot 21.

REITHRODONTOMYS PEROTENSIS sp. nov.

Type from Cofra de Perote, Vera Cruz, Mexico (altitude 9,500 ft.). No. 54424. ♂ ad. U. S. National Museum, Biological Survey Coll. May 31, 1893. E. W. Nelson and E. A. Goldman. Orig. no. 4912.

Characters.—Pelage long, soft, and woolly; ears large and dark; tail medium; similar in general to *chrysopsis* but color everywhere duller; top of head and middle part of back darker; skull and teeth much smaller.

Color.—Upperparts pale dull yellowish fulvous, tending toward buffy gray on head and toward fulvous on rump; top of head and back profusely lined with black hairs, most abundant along median line where they form a dark median dorsal area extending to base of tail; underparts buffy salmon, ankles and wrists brownish; fore and hind feet whitish; tail dark above, indistinctly paler below.

Cranial characters.—Skull in general similar to that of *chrysopsis* but smaller; braincase flatter; zygomata squarely spreading anteriorly, their outer sides parallel; rostrum shorter but equally slender; nasals ending on plane of premaxillæ; incisive foramina long and open; length of upper molar series 3.30 (contrasted with 3.80 in *chrysopsis*).

Measurements.—Type specimen (♂ ad.): total length 176 mm.; tail vertebræ 102; hind foot 19.

REITHRODONTOMYS ORIZABÆ sp. nov.

Type from Mount Orizaba, Puebla, Mexico (altitude 9,500 ft.). No. 53626. ♂ ad. U. S. National Museum, Biological Survey Coll. April 24, 1893. E. W. Nelson and E. A. Goldman. Orig. no. 4734.

Characters.—Size medium; ears blackish and well haired; tail long and rather slender; pelage long, soft and woolly; closely related to *chrysopsis* and *perotensis*.

Color.—Upperparts golden fulvous, becoming fulvous on rump, slightly darkened on posterior part of back with dark tipped hairs (almost exactly as in *chrysopsis*); lips and chin grayish; underparts buffy salmon; tail dark above, indistinctly paler below; wrists and ankles dark; fore and hind feet whitish.

Cranial characters.—Skull similar to that of *perotensis* but rostrum slightly broader; braincase narrower and more rounded; bullæ more transverse; molar teeth as in *perotensis*.

Remarks.—Externally *orizabæ* is hardly distinguishable from the more highly colored specimens of *chrysopsis*, although the head is more strongly fulvous, the ears decidedly more hairy, and the tail less

distinctly bicolor. The skull is nearer that of *perotensis*, from which it differs as above pointed out.

Measurements.—Type specimen (♂ ad.): total length 182 mm.; tail vertebrae 105; hind foot 20.

REITHRODONTOMYS COLIMÆ sp. nov.

Type from near timberline, Sierra Nevada de Colima, Jalisco, Mexico (altitude 12,000 ft.). No. $\frac{33671}{45706}$. ♂ ad. U. S. National Museum, Biological Survey Coll. April 21, 1892. E. W. Nelson and E. A. Goldman. Orig. no. 2447.

Characters.—Size smallest of the *chrysopsis* group; ears large and dark; tail rather short and sharply bicolor; pelage soft and woolly; similar in general to *chrysopsis* but decidedly smaller and with distinctive cranial characters.

Color.—Upperparts varying from buffy fulvous to bright golden fulvous strongly darkened on top of head and back by dark tipped hairs; underparts buffy salmon; wrists and ankles dark; fore feet whitish; hind feet brownish, becoming whitish toward toes; tail dusky above, whitish below, with distinct line of demarcation.

Cranial characters.—Skull similar to that of *chrysopsis toluæ* but decidedly smaller, with nasals ending on plane of premaxillæ instead of anterior to this plane; zygomata slightly more squarely spreading anteriorly; rostrum slightly shorter and broader; incisive foramina more broadly open; molar series same size, measuring about 3.6 mm.

Measurements.—Type specimen (♂ ad.): total length 165 mm.; tail vertebrae 90; hind foot 20. A female from type locality: total length 166; tail vertebrae 90; hind foot 20.

REITHRODONTOMYS COLIMÆ NERTERUS subsp. nov.

Type from foothill region of Sierra Nevada de Colima, Jalisco, Mexico (altitude 6,500 ft.). No. $\frac{33689}{45713}$. ♀ ad. U. S. National Museum, Biological Survey Coll. April 21, 1892. E. W. Nelson and E. A. Goldman. Orig. no. 2514.

Characters.—Similar to *colimæ*, but tail decidedly longer and less distinctly bicolor; pelage much shorter and coarser (not soft and woolly); skull slightly smaller, with smaller molars (molar series measuring 3.3 instead of 3.6).

Remarks.—This animal is particularly interesting in showing the changes that take place when a member of the *chrysopsis* group descends from the high altitudes at which all of the species live. The specimens of typical *colimæ* collected by Nelson and Goldman were found at altitudes of 10,000 and 12,000 feet, while those of the

present form were from four to five thousand feet lower. Externally subspecies *nerternus* appears to be slightly larger than the high mountain form, but the difference is mainly due to the greater length of tail [the skull is actually smaller than that of *colima*]. The pelage has lost the soft, woolly quality characteristic of the *chrysopsis* series and has become much shorter and coarser, resembling the ordinary members of the genus.

Measurements.—Type specimen (♀ ad.): total length 190 mm.; tail vertebrae 110; hind foot 20. Average of 2 adults from type locality: total length 186; tail vertebrae 105; hind foot 20.5.

REITHRODONTOMYS COSTARICENSIS JALAPÆ

subsp. nov.

Type from Jalapa, Vera Cruz, Mexico (altitude 4,000 ft.). No. 108538. ♂ ad. U. S. National Museum, Biological Survey Coll. May 10, 1901. E. W. Nelson and E. A. Goldman. Orig. no. 14712.

Characters.—Similar to *costaricensis*, but paler anteriorly and with greater admixture of black hairs on the back; hind feet grayish brown throughout, including toes, without distinct white edgings; hairs at base of claws white; ankles distinctly darker than feet; side of nose, upper lip (broadly), and underparts white, the plumbeous underfur showing through except on chin and nose patch; skull similar to that of *costaricensis*, but rostrum slightly shorter; braincase slightly more inflated; nasals truncate posteriorly about 1 mm. in front of ends of premaxillæ.

Measurements.—Type specimen (♂ ad.): total length 197 mm.; tail 119; hind foot 21.

REITHRODONTOMYS GOLDMANI sp. nov.

Type from Metlatoyuca, Puebla (altitude 800 ft.). No. 93096. ♀ ad. U. S. National Museum, Biological Survey Coll. February 12, 1898. E. A. Goldman. Orig. no. 12153.

Characters.—Size small, similar to *costaricensis*, but very much paler; ears smaller and brownish instead of blackish; tail shorter.

Color.—Upperparts uniform ochraceous fulvous not noticeably darkened by black hairs, but darkest on crown of head between ears; palest between eyes; sides of nose, upper lip (broadly), chin and underparts white; fore feet whitish; ankles and hind feet brownish, the brown fading insensibly into whitish of toes; tail dusky all round.

Cranial characters.—Skull similar to that of *costaricensis* but incisive foramina shorter and less expanded in middle; molar series slightly shorter.

Measurements.—Type specimen (♀ ad.): total length 190 mm. tail 109; hind foot 21.5.

REITHRODONTOMYS HIRSUTUS sp. nov.

Type from Ameca, Jalisco, Mexico (altitude 5,500 ft.). No. 82200. ♂ old. U. S. National Museum, Biological Survey Coll. Feb. 15, 1897. E. W. Nelson and E. A. Goldman. Orig. no. 10537.

Characters.—Size large (among the largest of the genus); tail long and slender; pelage coarse, almost hispid; ears rather short and pale; color grizzled yellowish fulvous.

Color.—Upperparts uniform yellowish fulvous, heavily lined with black hairs; the fulvous brightest on sides; underparts including sides of nose, lips (broadly) and fore feet buffy whitish (sometimes pale buffy fulvous); a dark spot on ankle; hind foot sparingly clothed with whitish hairs; tail dusky above, soiled whitish beneath, without sharp line of demarcation.

Cranial characters.—Skull large and substantial, in general like that of *peromyscus*; braincase somewhat flattened; rostrum medium or rather large; zygomata rather squarely spreading anteriorly; nasals broad and bluntly wedge-shaped posteriorly, ending decidedly anterior to elongated arms of premaxillæ; incisive foramina of moderate length and rather broadly open; bullæ rather small; upper molar series 3.7 mm.

Measurements.—Type specimen (♂ old): total length 233 mm.; tail vertebrae 143; hind foot 22.

REITHRODONTOMYS GRISEOFLAVUS sp. nov.

Type from Ameca, Jalisco, Mexico (altitude 4,000 ft.). No. 82196. ♂ ad. U. S. National Museum, Biological Survey Coll. Feb. 9, 1897. E. W. Nelson and E. A. Goldman. Orig. no. 10501.

Characters.—Size medium; ears medium or rather short; well haired; tail short; pelage coarse; similar to *hirsutus* from the same locality, but very much smaller, with shorter tail (relatively as well as actually) and more hairy ears.

Color.—Upperparts buffy gray anteriorly, becoming buffy yellowish or even buffy fulvous posteriorly, everywhere conspicuously and coarsely lined with black hairs; sides (including cheeks in full pelage) light golden fulvous; underparts whitish sometimes suffused with buffy or pale buffy fulvous, the fulvous of side of neck showing in axilla on inner side of fore leg; a small buffy or fulvous pectoral spot sometimes present; lips and chin broadly whitish; fore and hind feet whitish, a dark spot on ankles; tail brownish above, whitish below,

without sharp line of demarcation; ears brown with a conspicuous tuft of fulvous hairs at anterior base.

Cranial characters.—Skull small, light and thin, of normal form; zygomata standing out rather squarely anteriorly, the outer sides nearly parallel or only slightly narrower anteriorly; nasals relatively broad and bluntly pointed posteriorly falling short of premaxillæ; incisive foramina large and open for so small a skull; audital bullæ rather large; molar series rather small, measuring 3.20 in length. Compared with *tenuis* the skull is slightly larger, the braincase more inflated and higher.

Remarks.—This species is almost a miniature of *R. hispidus* of the same region and adds another case to those already mentioned in which two species, almost identical in external appearance, but one very much larger than the other, inhabit the same locality.

Measurements.—Type specimen (♂ ad.): total length 169 mm.; tail vertebræ 94; hind foot 22. Average of 3 from type locality: total length 169; tail vertebræ 97; hind foot 21.4.

REITHRODONTOMYS GRISEOFLOVUS HELVOLUS subsp. nov.

Type from Oaxaca City, Oaxaca, Mexico. No. 68387. ♀ ad. U. S. National Museum, Biological Survey Coll. Aug. 14, 1894. E. W. Nelson and E. A. Goldman. Orig. no. 6576.

Characters.—Similar to *griseoflovus* but upperparts everywhere conspicuously redder, the back and sides intense ochraceous or orange fulvous instead of buffy yellowish; grizzling of black hairs less conspicuous.

Remarks.—In color *helvolus* resembles *levipes* from San Sebastian much more closely than it does *griseoflovus*, but its skull is smaller and narrower than that of *levipes*, with shorter tooth row, in all of which respects it agrees with *griseoflovus*.

Measurements.—Type specimen (♀ ad.): total length 188 mm.; tail vertebræ 111; hind foot 20. Average of 6 from type locality: total length 182; tail vertebræ 105.5; hind foot 20.1.

REITHRODONTOMYS LEVIPES sp. nov.

Type from San Sebastian, Jalisco, Mexico (altitude 3,000 ft.). No. 88057. ♂ ad. U. S. National Museum, Biological Survey Coll. March 30, 1897. E. W. Nelson and E. A. Goldman. Orig. no. 10839.

Characters.—Size medium; ears rather small and thick; tail rather short; pelage coarse; color fulvous.

Color.—Upperparts fulvous, moderately lined with black hairs, brightest on sides, where in some specimens (as in the type) it is bright orange fulvous; underparts pale fulvous (in some specimens buffy); a dark spot on ankle; fore and hind feet usually soiled whitish.

Cranial characters.—Skull of medium size; braincase normal; rostrum small; zygomata squarely spreading; bullæ rather small; incisive foramina medium or rather large; molars rather small. Compared with *hirsutus* the skull is smaller; rostrum decidedly smaller; zygomata usually more widely and squarely spreading anteriorly; bullæ and teeth decidedly smaller. Compared with the small *griseoflavus* from Ameca, Jalisco, the skull averages slightly larger and broader; zygomata decidedly more widely and squarely spreading anteriorly; bullæ smaller; incisive foramina usually longer; molars slightly larger.

Measurements.—Type specimen (♂ old): total length 188 mm.; tail vertebræ 110; hind foot 21.

REITHRODONTOMYS LEVIPES OTUS subsp. nov.

Type from foothill region of Sierra Nevada de Colima, Jalisco, Mexico (altitude 6,500 ft.). No. $\frac{33670}{45705}$. ♀ ad. U. S. National Museum, Biological Survey Coll. April 11, 1892. E. W. Nelson and E. A. Goldman. Orig. no. 2439.

Characters.—Similar to *levipes* but pelage softer (less coarse), the dark hairs smaller and less noticeable; *ears decidedly larger; tail longer*; skull similar, but rostrum slightly longer; bullæ averaging slightly larger.

Measurements.—Type specimen (♀ ad.): total length 202 mm.; tail vertebræ 120; hind foot 22.

REITHRODONTOMYS LEVIPES TOLTECUS subsp. nov.

Type from Tlalpam, Valley of Mexico. No. 50746. ♀ ad. U. S. National Museum, Biological Survey Coll. Dec. 1, 1892. E. W. Nelson and E. A. Goldman. Orig. no. 3935.

Characters.—Similar in general to *levipes* but somewhat larger; color more yellowish (less fulvous) and much more heavily lined with black hairs; underparts nearly white, instead of fulvous; fore and hind feet white. Skull narrower; zygomata less widely spreading anteriorly; nasals longer and ending with premaxillæ; bullæ slightly larger.

Remarks.—Specimens from Patzcuaro, Michoacan, and Zimapan, Hidalgo, while less yellow, appear to be referable to this form.

Proc. Wash. Acad. Sci., Nov., 1901.

Measurements.—Type specimen (♀ ad.): total length 196 mm.; tail vertebrae 108; hind foot 21. Average of 2 specimens from type locality: total length 193; tail vertebrae 106; hind foot 21.5.

REITHRODONTOMYS SATURATUS CINEREUS subsp. nov.

Type from Chalchicomula, Puebla, Mexico. No. 53623. ♂ ad. U. S. National Museum, Biological Survey Coll. April 13, 1893. E. W. Nelson and E. A. Goldman. Orig. no. 4659.

Characters.—Similar to *saturatus* but very much paler and grayer, particularly the head and shoulders; tail shorter and more sharply bicolor. Skull similar but slightly smaller; rostrum shorter.

Measurements.—Type specimen (♂ ad.): total length 149 mm.; tail vertebrae 73; hind foot 19.

REITHRODONTOMYS SATURATUS ALTICOLUS
subsp. nov.

Type from Cerro San Felipe, near Oaxaca City, Oaxaca, Mexico (altitude 10,000 ft.). No. 68392. ♂ old, U. S. National Museum, Biological Survey Coll. Aug. 24, 1894. E. W. Nelson and E. A. Goldman. Orig. no. 6623.

Characters.—Similar to *saturatus* but tail somewhat shorter; rostrum shorter; bullae larger.

Measurements.—Type specimen (♂ old): total length 153 mm.; tail vertebrae 75; hind foot 19. Average of 2 males from type locality: total length 152; tail vertebrae 78.5; hind foot 18.5.

REITHRODONTOMYS DIFFICILIS sp. nov.

Type from Orizaba, Vera Cruz, Mexico (altitude about 4,500 ft.). No. 63735. ♂ ad. U. S. National Museum, Biological Survey Coll. Feb. 20, 1894. E. W. Nelson and E. A. Goldman. Orig. no. 5868.

Characters.—Size a little larger than *saturatus*; color fulvous; tail bicolor; ears medium or rather short; pelage coarse.

Color.—Upperparts fulvous, grizzled with black tipped hairs; underparts washed with pale fulvous except on chin and throat, which are whitish; fore and hind feet whitish; a dark spot on ankle; tail dusky above, whitish below, with a rather sharp line of demarcation.

Cranial characters.—Skull similar in general to that of *saturatus*, but incisive foramina more broadly open; molar series slightly shorter.

Measurements.—Type specimen (♂ ad.): total length 177 mm.; tail vertebrae 100; hind foot 19.5.

REITHRODONTOMYS DORSALIS sp. nov.

Type from Cabel, Guatemala. No. 77009. ♂ ad. U. S. National Museum, Biological Survey Coll. Jan. 14, 1896. E. W. Nelson and E. A. Goldman. Orig. no. 9112.

Characters.—Size rather large; ears and tail medium; tail bicolor; general color grayish above with dusky dorsal area.

Color.—Upperparts grayish washed with buffy, becoming buffy ochraceous on sides; top of head and broad dorsal area blackish (from profuse admixture of black tipped hairs); underparts buffy whitish, in many specimens suffused with buffy fulvous; lips and chin whitish; wrists dusky; fore and hind feet whitish; tail dark above, whitish below, with rather sharp line of demarcation.

Cranial characters.—Skull apparently of the *mexicanus* type, considerably larger than *saturatus*, but molar teeth small as in *saturatus*; rostrum rather long; braincase moderately rounded; basal length of skull 18.5; zygomatic breadth 11.8; molar series 3.20.

Measurements.—Type specimen (♂ ad.): total length 171 mm.; tail vertebrae 92; hind foot 19.

REITHRODONTOMYS MEGALOTIS ZACATECÆ subsp. nov.

Type from Valparaiso Mts., Zacatecas, Mexico. No. 91910. ♀ ad. U. S. National Museum, Biological Survey Coll. Dec. 6, 1897. E. W. Nelson and E. A. Goldman. Orig. no. 11859.

Characters.—Similar in general size and proportions to *megalotis* but much darker and yellower; ears and tail darker, pelage coarser and less fluffy. Upperparts pale dull fulvous brown, becoming buffy ochraceous on sides; top of head and back conspicuously lined with black hairs; underparts dark (instead of white), washed with buffy salmon; a pale fulvous pectoral patch. Skull like that of *megalotis* but braincase somewhat flatter and broader; nasals ending on plane of premaxillae instead of more anteriorly.

Remarks.—*R. m. zacatecæ* resembles subspecies *obscurus* from Sierra Madre, Chihuahua, very much more closely than it does typical *megalotis*. It differs from *obscurus* in having the upperparts less dark and more yellowish, the sides much deeper buffy ochraceous.

Measurements.—Type specimen (♀ ad.): total length 156 mm.; tail vertebrae 87; hind foot 17.5. Average of 4 specimens from type locality: total length 152; tail vertebrae 83; hind foot 17.5.

REITHRODONTOMYS MEGALOTIS OBSCURUS subsp. nov.

Type from Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico. No. 95277. ♂ ad. U. S. National Museum, Biological Survey Coll. Aug. 26, 1898. E. W. Nelson and E. A. Goldman. Orig. no. 12900.

Characters.—Similar to *megalotis* but everywhere very much darker, upperparts conspicuously lined with and darkened by black hairs; underparts buffy salmon (instead of white), with pale fulvous pectoral patch. Skull as in *megalotis*. Compared with *saturatus* which is a size larger, the ground color of upperparts is grayer (less fulvous) the underparts slightly more tinged with buffy salmon, and the pectoral region is pale fulvous. The skull, like that of *megalotis*, differs from *saturatus* in smaller size, shorter rostrum, usually shorter incisive foramina, smaller bullæ, and shorter molar series.

Measurements.—Type specimen (♂ ad.): total length 167 mm.; tail vertebræ 90; hind foot 19.

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NOVEMBER 29, 1901.

SEVEN NEW MAMMALS FROM MEXICO, IN-
CLUDING A NEW GENUS OF RODENTS.

BY C. HART MERRIAM.

AMONG the remaining undescribed mammals collected in Mexico by E. W. Nelson and E. A. Goldman, while engaged in field work for the Biological Survey of the U. S. Department of Agriculture, the following seven appear to be of more than ordinary interest.

BLARINA MAYENSIS sp. nov.

Type from a Maya ruin at Chichenitza, Yucatan. No. 108087. ♀ ad. U. S. National Museum, Biological Survey Coll. February 5, 1901. E. W. Nelson and E. A. Goldman. Orig. no. 14495.

Characters.—Similar in general to *mexicana* but pale plumbeous or slaty instead of blackish; unicuspidate teeth larger and broader.

Color.—Upperparts plumbeous, darker on nose; back with fine 'pepper and salt' appearance; underparts plumbeous, overlaid with ash brown, strongest on throat and breast.

Cranial characters.—Skull similar to that of *mexicana* but slightly longer and less massive; braincase lower (practically continuing plane of rostrum); molariform teeth large and full, not excavated anteriorly or posteriorly; large premolar smaller than that of *mexicanus*; 1st and 2d unicuspid large and swollen, much larger than those of *mexicanus*, and with inner tubercle obsolete, in this respect resembling *peregrina*.

Measurements.—Type specimen (♀ ad.): total length 102 mm.; tail vertebræ 29; hind foot 13.

ODOCOILEUS HEMIONUS CANUS subsp. nov.

Type from Sierra en Media, Chihuahua, Mexico. No. 99361. ♂ ad. U. S. National Museum, Biological Survey Coll. October 7, 1900. E. W. Nelson and E. A. Goldman. Orig. no. 13996.

Characters.—Similar in general to *O. hemionus* but in fresh winter pelage very much paler and grayer; throat pale gray, faintly vermiculated [in *hemionus* much darker and more heavily grizzled with blackish]; white of chin less sharply defined; breast less black; inguinal region white instead of buff; face, top of head, ears, and outer side of thighs much paler; dorsal neck stripe narrower, paler, and grizzled throughout; upper side of tail dark on basal half and in some specimens all the way to the black tip. The usual nose and tail markings are present but those on the nose are paler and more diffuse. The hoofs are larger than in *hemionus* from northern Arizona and eastern Colorado.

Cranial characters.—Skull like that of *hemionus* but muzzle broader; nasals broader and flatter (less pinched in); antlers similar but lighter and more slender, the beam rather short and concave anteriorly—not long and straight as in *eremicus* Mearns from the desert region about the Gulf of California.

Measurements.—Type specimen (♂ ad.): total length 1830 mm.: tail vertebrae 230; hind foot 500; height at shoulder 955.

TYLOMYS TUMBALENSIS sp. nov.

Type from Tumbala, Chiapas, Mexico. No. 76059. ♂ yg-ad. U. S. National Museum, Biological Survey Coll. Oct. 23, 1895. E. W. Nelson and E. A. Goldman. Orig. no. 8568.

Characters.—Size rather large, apparently larger than *nudicaudus* and with much larger hind feet; ears large and nearly naked; tail long and naked, the posterior half yellow; color brownish gray (becoming brownish fulvous with age?).

Color.—(Type specimen, yg-ad.) Upperparts dark gray, darkest on top of head and (broadly blackish) along median part of posterior half of back to base of tail; sides lightly washed with brownish; face dark gray; a broad dusky ring around eye; chin, pectoral region and small patch in inguinal region whitish; throat and belly plumbeous, washed with buffy fulvous; fore and hind feet and toes dark brownish, with a few white hairs at base of toes; basal half (or a little more than half) of tail blackish, terminal half yellow.

Cranial characters.—Skull large, long and flat. Differs from *nudicaudus* as follows: less massive and more slender; rostrum and

nasals decidedly more slender (nasals narrowly wedge-shaped, truncate posteriorly on plane of premaxillæ); zygomata weaker and less broadly spreading (probably due to immaturity); interparietal large, broadly and strongly convex anteriorly, tapering to point on sides; incisive foramina broadest posteriorly and ending on plane of front of molars; bullæ slightly larger; upper incisors weaker and more slender; molar series very large and heavy, decidedly larger and longer than in *nudicaudus* (measuring 9.5 mm.).

Measurements.—Type specimen (♂ yg-ad., probably not full grown): total length 448 mm.; tail vertebrae 234; hind foot 46.

TYLOMYS BULLARIS sp. nov.

Type from Tuxtla, Chiapas, Mexico. No. 76058. ♂ im. U. S. National Museum, Biological Survey Coll. Sept. 7, 1895. E. W. Nelson and E. A. Goldman. Orig. no. 8406.

Characters.—Type and only specimen too young to give reliable external characters. Ears very large, black, and sparsely haired; tail long and slender, naked, basal third blackish, terminal two-thirds yellow. Color paler and grayer than young of corresponding age of *nudicaudus*; underparts white; upper lip and patch on side of nose whitish; face much paler than in *nudicaudus*; fore feet brown to base of toes; toes and edging on outer side of foot white; hind feet to toes dark brown; toes white.

Cranial characters.—Skull similar to that of *nudicaudus* of corresponding age, but interparietal broader on outer side; zygomata more strongly spreading posteriorly; bullæ widely different, large and broadly rounded anteriorly, without anterior prolongation, suggesting the condition in *Ototylomys*. Teeth of same size as in *nudicaudus*.

Remarks.—I am reluctant to describe a new mammal from an immature specimen, but in this instance no other course seems open. The white upper lip and patch on side of nose, the pale grayish plumbeous of the upperparts, and the peculiar character of the audital bullæ seem to distinguish the species from its congeners. It is hoped that adults will be obtained in the near future.

Measurements.—Type specimen (♂ im., not nearly full grown): total length 324 mm.; tail 158; hind foot 37.5.

OTOTYLOMYS gen. nov.

External characters.—Appearance rat-like; ears large, thin and naked; tail long and naked.

Cranial characters.—Skull flattened, with large interparietal and strongly developed superciliary ridges which form a horizontal shelf

over orbits and reach posteriorly to occiput, as in *Tylomys*, but differing from *Tylomys* in the following characters:

1. Bullæ rotate-capsular, inflated, as broad anteriorly as posteriorly, without narrow anterior prolongation; axes essentially parallel to axis of skull. Similar to those of *Xenomys* but smaller.

2. Anterior or maxillary root of zygoma strongly notched above (at base of rostrum) as in *Peromyscus* and *Xenomys*.

3. Outer lip of anterior opening of antorbital vacuity *vertical* as in *Neotoma* and *Peromyscus*, not concave as in *Tylomys*.

4. Fossa at base of rostrum less developed.

5. Incisive foramina enormous, as broadly open anteriorly as posteriorly.

6. Angle of jaw excavated posteriorly, leaving a sharp point projecting backward as in *Peromyscus*, the infracondyloid notch correspondingly long and deep (differing widely from the broadly expanded and rounded angle of *Tylomys*, which is convex posteriorly instead of sharply concave).

7. Coronoid process reduced to a mere point as in *Peromyscus*; postcoronoid notch flat and nearly horizontal.

OTOTYLOMYS PHYLLOTIS sp. nov.

Type from Tunkas, Yucatan. No. 108099. ♂ old, U. S. National Museum, Biological Survey Coll. Feb. 17, 1901. E. W. Nelson and E. A. Goldman. Orig. no. 14551.

Characters.—Size of *Mus rattus* (equaling the smaller species of *Neotoma*); ears enormous and leaf-like; tail long (as long as head and body), naked, the annulations and scales broad. General appearance as in *Tylomys* but size smaller, ears much larger, upperside of tail dark throughout (terminal half not yellow).

Color.—Upperparts varying from grayish brown to very dull fulvous brown, in some specimens conspicuously mixed with black-tipped hairs; underparts, including inner side of fore and hind legs, white or buffy white; ankles and wrists dark: fore and hind feet whitish; face brownish or grayish, washed on cheeks and around eye with pale fulvous; tail brownish dusky above, irregularly yellowish beneath. Young grayish plumbeous with top of head (from between eyes posteriorly) and middle part of back darker.

Cranial characters (additional to generic characters already given).—Rostrum long and slender; nasals long and slender; their sides nearly parallel, truncate posteriorly about on plane of premaxillæ; zygomata moderately spreading, broadest posteriorly; interparietal

large, broadly strap shaped or subquadrangular, but narrower on outer sides than in middle.

Measurements.—Type specimen (♂ old): total length 303 mm.; tail 148; hind foot 28. Average of 8 adults of both sexes: total length 297; tail 150; hind foot 27.5.

OTOTYLOMYS PHYLLOTIS PHÆUS subsp. nov.

Type from Apazote, near Yohaltun, Campeche. No. 107940. ♀ ad. U. S. National Museum, Biological Survey Coll. December 28, 1900. E. W. Nelson and E. A. Goldman. Orig. no. 14369.

Characters.—Similar to *O. phyllotis* but somewhat smaller; tail much smaller and shorter; upperparts much darker, the posterior median dorsal region dusky, the sides and fore-back grayish brown with a pale dull fulvous tinge. Skull similar to that of *phyllotis* but slightly smaller; rostrum more slender; frontals and nasals flatter and in same plane (nasals not decurved); superciliary shelves not so strongly developed.

Measurements.—Type specimen (♀ ad.): total length 266 mm.; tail 136; hind foot 26.5.

CALLOSPERMOPHILUS MADRENSIS sp. nov.

Type from Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (altitude 7,000 feet). No. 95363. ♀ ad. U. S. National Museum, Biological Survey Coll. August 27, 1898. E. W. Nelson and E. A. Goldman. Orig. no. 12923.

Characters.—Similar to *Callospermophilus lateralis*, but tail about half as long.

Color.—(In fall pelage) ground color above grizzled grayish, becoming dull grayish fulvous on rump; black stripes nearly obsolete; white stripes buffy gray, slightly grizzled with black hairs; fore and hind feet whitish; underparts soiled whitish more or less grizzled; tail above grizzled dull grayish fulvous and black, below yellowish.

Cranial characters.—Skull similar to that of *lateralis*, but rostrum less swollen.

Measurements.—Type specimen (♀ ad.): total length 233 mm.; tail vertebræ 58; hind foot 39. Average of 8 females from type locality; total length 228; tail vertebræ 62; hind foot 39.

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NOVEMBER 29, 1901.

PAPERS FROM THE HOPKINS STANFORD GALA-
PAGOS EXPEDITION, 1898-1899.

VI.

THE ISOPODS.

BY HARRIET RICHARDSON,

COLLABORATOR, SMITHSONIAN INSTITUTION.

THE Isopods, collected by the Hopkins Stanford Expedition, comprise four species of which two, new to science, are here described. One of the new species comes from Clipperton Island; the other was collected at sea about 300 miles north of Galapagos. The two species previously known are for the first time recorded from the localities cited.

Family TANAIIDÆ.

TANAIS STANFORDI sp. nov.

Description of Male.—Head very broad at base, attenuated anteriorly, where it is produced straight forward, forming a sort of neck. The anterior margin of this projection has a triangular median point, on either side of which the first pair of antennæ are inserted in the depression formed by the median point and the acute antero-lateral angles of the projection. The eyes, which are black and distinct, are situated in these lateral angulations. The first pair of antennæ are composed of three joints each, the first joint very much elongated, about equal to two-thirds the length of the head; the other two joints

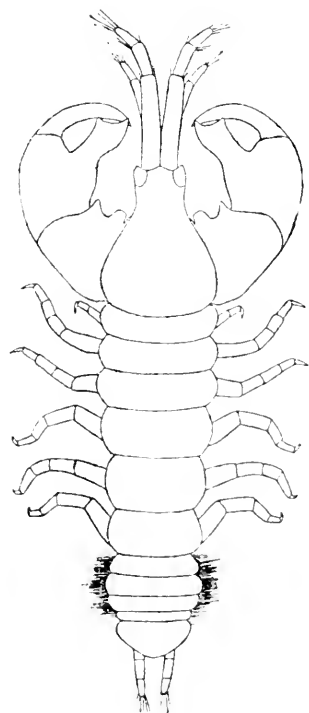


FIG. 58. *Tanais stanfordi*, male.

are short, subequal, both together but little longer than half the length of the first joint. The second pair of antennæ extend only to the end of the second joint of the first pair. Both pairs of antennæ terminate in long hairs.

The first thoracic segment is coalesced with the head. The second segment is short, the next two equal in length and longer than the first. The last three are subequal and the longest.

There are five abdominal segments, including the terminal one. The first three are subequal in length; the fourth is half as long as any of the preceding ones; the terminal segment is rounded posteriorly.

The three pairs of pleopods are densely setose. The uropods are single-branched, each branch composed of three joints.

The first gnathopods have the hand strongly chelate and very large, the finger and thumb gaping. The finger is long and curved; the thumb elongated and squarely produced; the upper surface is provided with two teeth, a slight depression separating them. The carpus is produced at the upper inner angle in a strong tubercle.

The first pereopods are very small, feeble and almost inconspicuous; the second pair longer, but not quite as long as the other four pairs, which are equal in length.

Description of Female.—Head broad at base and attenuated anteriorly, but not produced in a straight process as in the male. The anterior margin has a triangular median point on either side of which the first pair of antennæ are inserted in the depression formed by the median point and the antero-lateral angles. The eyes are situated as in the male. The first pair of antennæ are much shorter than those of the male. The first joint is longest, equal to one-third the length of the head, the two following joints are subequal and



FIG. 59. *Tanais stanfordi*; hand of male.

both together as long as the first joint. The second pair of antennæ do not quite reach the end of the second joint of the first pair.

The thoracic segments are similar to those of the male.

The abdomen and the uropods are also similar to those of the male.

The gnathopods have the hand strongly chelate, but very much smaller than the hand of the male, the finger and thumb not gaping. The pereopods are all alike and of equal length.

Color of specimens white with more or less numerous markings of brown.

A number of specimens of both males and females were found at Clipperton Island Lagoon.

Type, U. S. National Museum. Cat. No. 25172.

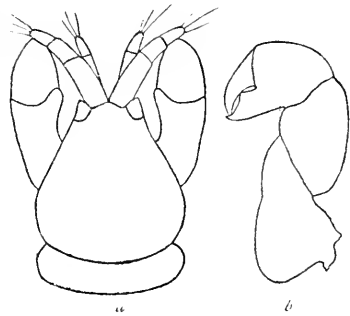


FIG. 60. *Tanais stanfordi*. a. Head of female. b. Hand of female.

Family CYMOTHOIDÆ.

ÆGATHOA EXCISA sp. nov.

Description.—Body narrow, elongate, three and a half times longer than broad.

Head quadrangular, the front produced over and beyond the basal joints of the antennæ, the anterior margin of which is deeply excavate, the lateral margins rounded. Eyes large, occupying the greater part of the area of the head, but not contiguous. The first pair of antennæ extend a little beyond the posterior margin of the head, and are composed of eight joints. The second pair of antennæ are equal in length to the first pair, and are composed of about fourteen joints.

The first and fifth thoracic segments are somewhat longer than any of the others. The epimera are short, not reaching beyond the posterior angles of their respective segments, but all equalling these segments in length.

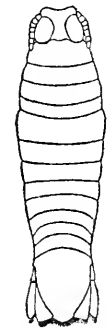


FIG. 61. *Ægathoa excisa*. All of the first five abdominal segments are distinct and subequal; terminal segment is about equal in length to the five preceding ones, is triangularly shaped, with rounded extremity, and has a lateral incision on each side near the posterior

margin. At the base of this segment there is a deep depression. The uropods do not surpass the terminal segment. The outer branch is narrow, lanceolate; the inner branch is broad, truncate; both branches are equal in length.

The color of the entire body is a dark bluish gray with the exception of the terminal segment and the uropods, which are a light yellow.

One specimen was taken from the fin of a dolphin (*Coryphæna hippurus*) in 5° N. lat., 90° W. long.

Type U. S. National Museum. Cat. No. 25173.

***Meinertia gaudichaudii* (Milne-Edwards).**

Cymothoa gaudichaudii Milne-Edwards, Hist. Nat. Crust., III, p. 271.

Ceratothoa rapax HELLER, Reise Novara, Crust., p. 146, pl. XII, f. 17.

Ceratothoa gaudichaudii SCHIÖDTE and MEINERT, Naturhistorisk Tidsskrift (3), XIII, 1881-83, p. 335-340, pl. XIII, figs. 11-15, pl. XIV, figs. 1-5.

Meinertia gaudichaudii STEBBING, Hist. Crust., 1893, p. 354.

Black Bight, Albemarle Island, Galapagos Islands; 200 miles north of Wenman Island, Galapagos Islands.

Family LIGIIDÆ.

***Ligia exotica* (Roux).**

Ligia exotica, ROUX, Crust. Médit., p. 3, pl. XIII, fig. 9.—Budde-Lund, Crust. Isop. Terrestria, pp. 266-268, 1885.

Ligia gaudichaudii, MILNE-EDWARDS, Hist. Nat. des Crust., III, p. 157.—DANA, Exp. Ex., p. 741, pl. XLIX, figs. 6^{a-b}.—NICOLET in Gay's Hist. Chile, III, p. 265.

(?) *Ligia (Italica) coriacea*, KOCH, Deutschl. Crust., p. 36.

Guadalupe and Clipperton Islands.

PROCEEDINGS
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VOL. III, PP. 569-576. [TEXT FIGURES 62-66.] DECEMBER 11, 1901.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XXVI.

HARRIMANELLA, A NEW GENUS OF HEATHERS.

BY FREDERICK V. COVILLE.

THE German naturalist Pallas, for more than forty years the leader of Russian researches in natural history, published in 1788 a description of a new heather from eastern Siberia under the name *Andromeda stelleriana*. Willdenow, in 1799, transferred the species to the genus *Erica*. In the year 1834 David Don, a Scotch botanist, placed it in the genus *Bryanthus*, while Sir W. J. Hooker, studying the same plant independently, referred it back to *Andromeda*, citing the opinion of another botanist who considered it a *Menziesia*. In 1839 the plant was referred by De Candolle to *Cassiope*, and under the name *Cassiope stelleriana* it has since passed.

The genus *Cassiope* was founded by David Don, in 1834,¹ the plants originally included in it consisting of five species taken out of the older genus *Andromeda*. Two of these, *tetragona* and *hypnoides*, were species described by Linnæus and occurring in northern Europe; two others, *lycopodioides* and *ericoides* had been described by Pallas from eastern Siberia, and one, *fastigiata*, by Wallich from the Himalayas. *Cassiope tetragona* (*Andromeda tetragona* L.) was named by Don as the type of his new genus. To *Cassiope* belong, therefore, the species *tetragona* and such others as are congeneric with it. A

¹D. Don, Edinb. New Phil. Journ. 17: 157. 1834.

Proc. Wash. Acad. Sci., December 1901.

careful examination of the so-called *Cassiope stelleriana* makes it clear that this species is not a true *Cassiope* but should be made the type of a hitherto undescribed genus, which is characterized as follows:

Harrimanella gen. nov.

Plant belonging to the tribe Andromedeae, of the family Ericaceae; leaves empetriform, many-ranked, decurrent; flowers pentamerous, nodding, singly terminal on ordinary leafy branches; calyx ebracteolate, the sepals distinct, imbricated in the bud, not becoming fleshy

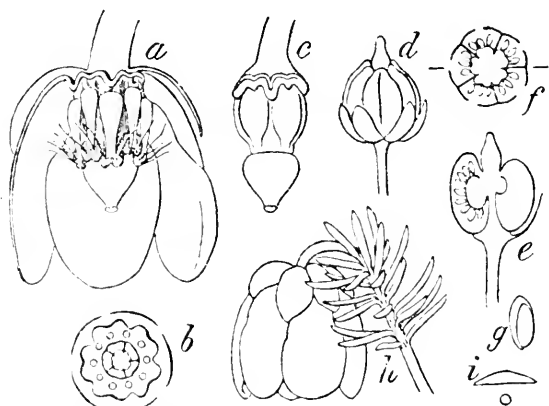


FIG. 62. *Harrimanella stelleriana*. *a*, flower, with part of calyx and corolla cut away ($\times 5$); *b*, diagram of flower; *c*, ovary and style ($\times 5$); *d*, fruit ($\times 2$); *e*, longitudinal section of fruit ($\times 2$); *f*, transverse section of fruit ($\times 2$); *g*, seed ($\times 10$); *h*, end of branch, showing leaves and position of flower ($\times 3$); *i*, outline of transverse section of leaf ($\times 10$).

and not exceeding the capsule in fruit; corolla campanulate, vertically plaited at the base, the lobes pendent and overlapping; filaments tumid below, the broad anthers situated in two planes of five each, biaristate below the apex, opening by large pores; style short, stout, ovoid, persistent on the fruit; capsule globose, many-seeded; seed oblong, slightly or not at all winged.

The genus is named for Mr. E. H. Harriman, of New York, through whose courtesy the opportunities and pleasures of his voyage to Alaska, in 1899, were shared by a party of scientific investigators. It is hoped that the Alaska heather, *Harrimanella stelleriana*, one of the most charming and beautiful little plants of the whole Alaskan flora, will serve as a happy reminder of the expedition to all its members.

The genus *Cassiope*, from which *Harrimanella* is now segregated, has opposite, cupressiform, closely sessile leaves, conspicuously swollen or spurred at the base and closely appressed to the stem, the branches

thus becoming quadrangular. The flowers of *Cassiope* occur singly in the axils of the leaves, the pedicels bearing at the base four membranaceous bracts; each sepal has a transverse fold at the base as if the organ had first been bent sharply backward, then at a slightly higher point bent sharply forward again, a character best brought out by a longitudinal median section of a sepal; the corolla is not plaited at the base and the usually short lobes are recurved and not overlapping in anthesis; the anthers lie in a single plane; and the style is elongated, slender, and nearly cylindrical. The seeds may furnish a generic character, as suggested by the conspicuous apical appendage in *Cassiope mertensiana* and the absence of any such appendage in *Harrimanella stelleriana*.

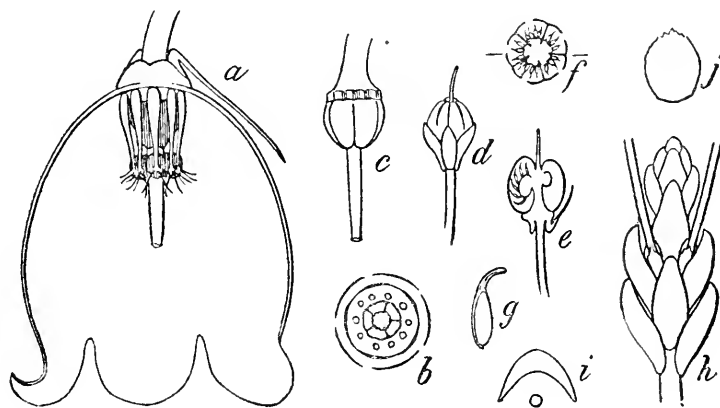


FIG. 63. *Cassiope mertensiana*. *a*, flower, with part of calyx and corolla cut away ($\times 5$); *b*, diagram of flower; *c*, ovary and style ($\times 5$); *d*, fruit ($\times 2$); *e*, longitudinal section of fruit ($\times 2$); *f*, transverse section of fruit ($\times 2$); *g*, seed ($\times 10$); *h*, end of branch, showing leaves and position of flowers ($\times 3$); *i*, outline of transverse section of leaf ($\times 10$); *j*, bract from base of pedicel ($\times 5$).

Of the ten species that have been referred to *Cassiope*, seven are still referable to the genus as here restricted, two are referable to *Harrimanella*, and one must be excluded from both. The species of true *Cassiope* are distinguishable by their vegetative characters alone, as indicated in the following key:

KEY TO THE SPECIES OF CASSIOPE, BASED ON LEAF CHARACTERS.

Leaves with a deep channel on the back.

Leaf margins with a few coarse bristles.

C. ericoides (Pall.) D. Don.

Leaf margins pubescent or fimbriate, but without bristles.

Leaves with scattered pubescence on the back and margins, but without membranaceous or fimbriate margins or a terminal bristle..... *C. tetragona* (L.) D. Don.

Leaves without hairs or fimbriae except on the margins or in the furrow.

Leaves with persistent white membranaceous fimbriate margins connecting with a terminal acumination.

C. fastigiata (Wall.) D. Don.

Leaves with the marginal fimbriae early deciduous, a slender terminal bristle persistent.

C. selaginoides Hook. f. & Thom.

Leaves not channeled on the back.

Leaves not ciliate..... *C. mertensiana* (Bong.) D. Don.

Leaves more or less ciliate on the margins or at the apex when young.

Leaves shining, armor-like, without white margins.

C. redowskii (Ch. & Schl.) G. Don.

Leaves dull, with white margins.

C. lycopodioides (Pall.) D. Don.

Of these species one, *tetragona*, is circumpolar, two, *fastigiata*

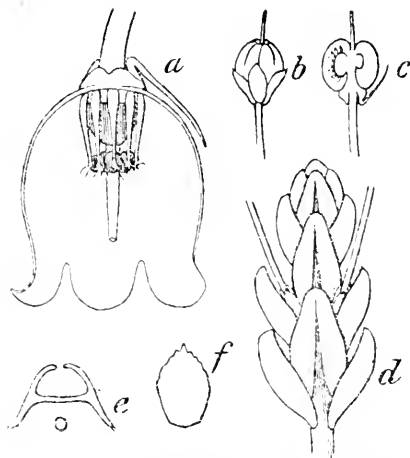


FIG. 64. *Cassiope tetragona*. a, flower, with part of calyx and corolla cut away (X5); b, fruit (X2); c, longitudinal section of fruit (X2); d, end of branch, showing leaves and position of flowers (X3); e, outline of transverse section of leaf (X10); f, bract from base of pedicel (X5).

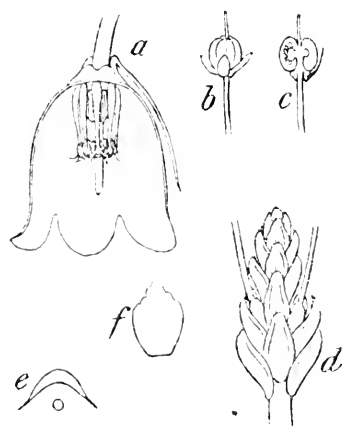


FIG. 65. *Cassiope lycopodioides*. a, flower, with part of calyx and corolla cut away (X5); b, fruit (X2); c, longitudinal section of fruit (X2); d, end of branch, showing leaves and position of flowers (X3); e, outline of transverse section of leaf (X10); f, bract from base of pedicel (X5).

and *selaginoides*, are Himalayan; two, *ericoides* and *redowskii*, belong to eastern Siberia; one, *lycopodioides*, extends from Alaska to

Japan; and one, *mertensiana*, is confined to northwestern North America. Three species of Cassiope, therefore, are found on the American continent, *tetragona*, *lycopodioides*, and *mertensiana*.

The species which must be excluded from both Cassiope and Harrimanella is *C. oxycoccoides* Gray.¹ Our whole knowledge of this plant is based on a single flowering twig 43 mm. long, collected by Dr. Leonhard Stejneger August 22, 1882, on the northern shore of Bering Island, off the east coast of Siberia, on "a rounded hill, about 300 feet high, just behind the fishing settlement of Saranna." An examination of the specimen, which is in the Harvard University Herbarium, shows that it differs in various ways from both Cassiope and Harrimanella. Its leaves are situated in whorls of three and very closely resemble broad leaves of *Chamaecistus procumbens*. They are, however, smooth on the back between the midrib and margin and they have an apical gland similar to that of *Vaccinium vitisidaea*. The three pentamerous flowers are borne on short bibracteolate pedicels in a tribracteate umbel on a short terminal peduncle. The calyx does not differ from that of Harrimanella, while the corolla is of the urceolate short-lobed form found in Cassiope. The style is cylindrical as in Cassiope, but the stamens differ from those of both Cassiope and Harrimanella. In both these genera the pollen pore, the two awns, and the point of attachment of the filament are close to the apex of the anther, but in the plant under consideration the filament is attached to the base of the anther, only the two awns and the pollen pores being apical. Although the fruit is unknown, the whorled character of the leaves and the structure of the stamens give reason for a surmise that the plant belongs to the Ericaceae instead of the Andromedeae. Apparently, however, it is not congeneric with any known species of the Ericaceae. Its corolla is not chartaceous; it is a depressed plant barely projecting above the mosses and lichens among which it grows; its leaves have peculiar apical glands; and it is geographically isolated from the rest of the Ericaceae, none of which are known from either northeastern Asia or northwestern America. I venture to propose for it the generic name **Arcterica**, the whole name being **Arcterica oxycoccoides** (Gray). It is greatly to be desired that future travelers visiting Bering Island procure a good series of both flowering and fruiting specimens of this rarest of plants.

The two Cassiopees which are now referred to Harrimanella may be distinguished as follows:

¹ Gray, Proc. Am. Acad. 20: 300. 1885 (Jan. 26); Gray in Stejneger, Proc. U. S. Nat. Mus. 7: 534. 1885 (Jan. 27).

KEY TO THE SPECIES OF HARRIMANELLA.

- Leaves divergent, linear to linear oblong, obtuse or broadly acute at the apex, the margins somewhat erose but not serrulate; peduncles in flower barely or not at all exceeding the leaves, in fruit about twice as long; corolla about 6 mm. long; capsule commonly about 4, sometimes 5, mm. in diameter *H. stelleriana*.
 Leaves loosely appressed, lanceolate-subulate, acute, minutely serrulate on the margins; peduncles few to several times as long as the leaves in both flower and fruit; corolla commonly 4 to 5 mm. long; capsule about 3 mm. in diameter..... *H. hypnoides*.

Harrimanella stelleriana (Pall.).

SYNONYMY.

- Andromeda stelleriana* Pall. Fl. Ross. 12: 58. 1788.
Erica stelleriana Willd. Sp. Pl. 2: 387. 1799.
Andromeda empetrifolia Mertens; Bong. Mem. Acad. Petersb. vi. Math. & Nat. 2: 153. 1831.
Bryanthus stelleri D. Don, Edinb. New Phil. Journ. 17: 160. 1834.
Menziesia stelleriana Fisch.; Hook. Fl. Bor. Am. 2: 37. 1834.
Cassiope stelleriana DC. Prod. 7: 611. 1839.

EARLIER ILLUSTRATIONS.

- PALLAS, Fl. Ross. t. 74. f. 2. 1788, as *Andromeda stelleriana*.
 HOOKER, Fl. Bor. Am. t. 131. 1833-40, as *Andromeda stelleriana*.
 HARRIMAN ALASKA EXPED. 1: 32. 1901, as *Cassiope stelleriana*.

DISTRIBUTION.

The original specimens of *Harrimanella stelleriana* were collected in eastern Siberia by Steller, probably on Bering Island. The species has since been collected from Kamchatka southward to the mountains of northern Japan, but apparently does not extend on the Asiatic continent far from the Pacific. In America it occurs from Unalaska eastward and southward along the whole coast of Alaska through British Columbia and as far as Mount Rainier in the Cascade Mountains of Washington. Toward the north, as in Prince William Sound, it sometimes descends to sea level but ordinarily it grows near timber line or in the upper elevations of the forest within a thousand feet of timber line. On Mount Rainier it has been collected at an elevation of 5,500 feet.

GENERAL REMARKS.

We first saw this plant, on the Harriman Expedition, at the summit of White Pass, Alaska, where it grew with the crowberry (*Empetrum nigrum*) and reindeer moss (*Cladonia rangiferina*) that carpeted the mountain slopes at timber line. On the east side of Muir Inlet, in Glacier Bay, at a point about six miles below the end of

Muir Glacier, we found it again, growing at an elevation of about 2,000 feet in the rather open forests of black hemlock (*Tsuga mertensiana*). At this time, June 12th, it was not quite in flower. The first flowering specimens were found June 16th on Mount Verstovia, near Sitka. The plant occurred in abundance from an elevation of 2,400 feet to the summit, and one patch was seen on an exposed ridge at about 1,500 feet. Near sea level on the west shore of Yakutat Bay on the glacial gravels half covered with vegetation was seen a single yellowed plant with pale whitened flowers, doubtless the product of a stray seed from the mountains above. At various points in Prince William Sound the plant grew in great profusion and was in full bloom at the time of our visit, June 24th to 29th, occurring on the mountain slope back of Orca among the dwarfed black hemlocks at 1,300 to 1,600 feet, in Port Wells, and in Columbia Fiord. This is the plant that lead Mr. Gilbert to adopt the name Heather Island for the rocky, mossy, scantily timbered island that stands in Columbia Fiord immediately in front of the Columbia Glacier. On this spot, chilled by the cold current of air flowing down from the great glacier, grew this and other arctic-alpine plants in profusion all the way down to sea level. On a timbered nunatak rising from the glacier about eight miles from its front the plant occurred to an elevation of about 3,000 feet. On the mountains at the head of English Bay, Kadiak Island, it was flowering abundantly at 1,500 to 3,000 feet. It was found on the Alaska Peninsula at Kukak Bay by Mr. Kearney and at Chichagof Bay by Mr. Palache, at an elevation of about 1,000 feet, and sparingly on the Shumagin Islands by Mr. Kincaid and Mr. Saunders at the same altitude, flowering till the middle of July.

Harrimanella hypnoides (L.).

SYNONYMY.

Andromeda hypnoides L. Sp. Pl. 1: 393. 1753.

Cassiope hypnoides D. DON, Edinb. New Phil. Journ. 17: 158. 1834.

EARLIER ILLUSTRATIONS.

LINNÆUS, Fl. Lapp. t. 1. f. 3. 1737, as *Andromeda hypnoides*.

OEDER, Fl. Dan. t. 10. 1761, as *Andromeda hypnoides*.

PALLAS, Fl. Ross. t. 73. f. 2. 1788, as *Andromeda hypnoides*.

CURTIS, Bot. Mag. t. 2936. 1829, as *Andromeda hypnoides*.

ENGLER & PRANTL, Nat. Pfl. 4¹: f. 12. A. 1889, as *Cassiope hypnoides*.

DISTRIBUTION.

The plant on which Linnæus based his description came from the mountains of Lapland, but the species is now known to occur in arctic

or arctic-alpine situations from the Ural Mountains westward through northern Europe, Iceland, and Greenland to the American continent on

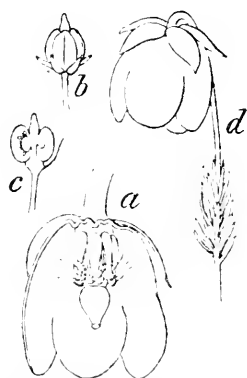


FIG. 66. *Harrimanella hyfnoides*. *a*, flower, with part of calyx and corolla cut away ($\times 5$); *b*, fruit ($\times 2$); *c*, longitudinal section of fruit ($\times 2$); *d*, end of branch, showing leaves and position of flower ($\times 3$).

the western side of Baffins Bay, and thence southward through Labrador to the high mountains of Quebec, New England, and New York. The species is not known to occur in Siberia, Alaska, or central and western British America.

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PRELIMINARY REVISION OF THE PUMAS (*FELIS*
CONCOLOR GROUP).

By C. HART MERRIAM.

THE Pumas or Cougars form a strongly marked group, easily distinguished from the other Cats by the following characters (taken collectively): size large; build slender; head relatively small; tail long; body without markings (except in the very young). They are confined to America, where they range from southern Patagonia northward over nearly the whole of South and Central America, Mexico, and the United States, and reach their northern limit in southern Canada (Ontario in the east; British Columbia in the west). During the past century their range in the United States has become greatly restricted and over large areas they have been exterminated by man. They are not now known to inhabit New England, with the possible exception of the Green Mts. of Vermont, though formerly found in Vermont, Massachusetts, Connecticut, and Rhode Island. In the State of New York they were killed in the Catskills within the memory of our fathers, and in the Adirondacks, where until recently they were fairly common, a few probably still exist. They still occur in Florida and in the lowlands of Louisiana, but in other parts of the United States are rather strictly confined to mountainous regions.¹

Pumas were known to the early naturalists, and in 1771 Linnaeus named the Brazilian species *Felis concolor*. From time to

¹ Their distribution by States was carefully worked out by Dr. F. W. True in 1889—Report U. S. National Museum for 1889, pp. 595-600, 1891.

Proc. Wash. Acad. Sci., December 1901.

time other names were proposed, some deliberately intended to replace Linnæus's *concolor*, others to distinguish forms belonging to particular regions. But for a long time the name *concolor* was used in a collective sense for the entire group and this practice has prevailed until very recently. In 1896 Cory recognized the Florida Puma as distinct from *concolor*; and in 1897 I described as new two forms from the west—one from the northern Rocky Mountains; the other from the northwest coast region. Of late the belief has spread that several quite different animals were concealed under the name *concolor*, but the absence of sufficient material for comparison has delayed the revision of the group.

Recently the Hon. Theodore Roosevelt, President of the United States, presented to the U. S. Biological Survey a series of 12 skulls of the Rocky Mountain Cougar or Mountain Lion, taken from animals killed by him in Colorado in January and February of the present year (1901).¹ The examination of these skulls led to comparisons with skulls from other localities, and gradually to a study of such specimens from various parts of North and South America as could be easily brought together. The more important conclusions resulting from this study are here recorded.

The Roosevelt series of skulls is of unusual value, not only because each skull is accompanied by precise data giving the color, measurement and weight of the animal from which it was taken, but also and more particularly because the study of so large a series from a single locality shows the nature of the differences resulting from sex and age, affords an index to the kind and quantity of individual variation, and sets a standard for comparison with other members of the group—thereby furnishing a means of estimating the probable value of particular cranial or dental peculiarities observed in single skulls from remote regions.

A discussion of the variations presented by the Roosevelt

¹Since this paper was written Mr. Roosevelt has published, in *Scribner's Magazine* (October and November, 1901), an account of his Colorado Cougar hunt, in the course of which he discusses the habits of Cougars in general. His article is by far the most noteworthy contribution thus far made to the life history of these animals.

series, with a detailed table of measurements of the skulls, will be found under the species to which they belong—*Felis hippolestes*. It may be stated here however that the limits of variation for adults of each sex fall within surprisingly narrow bounds. This points toward stability in the characters presented by other species of the group. In this connection I may be permitted to state what I believe to be a general law (confirmed by critical studies in most groups of North American mammals), namely, that completely differentiated types (specific or sub-specific) from the areas where the typical forms occur, show relatively little individual variation, while the intergrades connecting such types, and also local forms not yet completely established, show a wide range of individual variation.

Specific characters in some groups are shared equally by the two sexes, but this is not the case with the Pumas, for these animals conform to the rule among the Carnivora that the male is the larger and more highly developed. The male Puma is much larger and more powerful than the female, the skull and teeth are much larger and more massive, and, what is still more important, the male alone attains complete specific differentiation. By this is meant that the distinctive cranial characters of the various forms are only fully developed in the males, skulls of females resembling each other so closely that in several cases they are distinguished with difficulty.

While the skulls of the several members of the group bear a strong general resemblance to one another, marked differences exist, chiefly in the proportions of the several parts. The most conspicuous of these are in the degree of elevation or depression of the face and frontal region, the extremes of which are presented by *Felis patagonica* of the Southern Andes and *F. olympus* of the Puget Sound region. In *Felis patagonica* the skull is long and low, the face slopes strongly backward, the orbital process of the jugal rises only slightly above the body of the bone, the frontal region is depressed and flattened, and the highest part of the cranium is behind the postorbital processes. In *F. olympus* the face rises abruptly, the orbital process of the jugal rises strongly and suddenly, the frontal region is highly elevated and swollen, and the highest part of the cranium is in

front of the postorbital processes, the resulting physiognomy being widely different from that of *F. patagonica*.

Other important differences occur. The massive skulls of *F. hippolestes* and *olympus*, with their heavy powerful underjaws, contrast strongly with the relatively thin and light skull of *F. concolor*, with its small and slender jaw: and the huge canines and carnassials of *F. puma* contrast strikingly with the slender and light corresponding teeth of *F. bangsi*.

Of the teeth, the carnassials furnish the most valuable characters, and in distinguishing the species the upper is of service more often than the lower. The significant variations in the upper carnassial are in the length, breadth, form of outer side, relative size of the cusps, and degree of development of the inner tubercle or protocone. The tooth as a whole is largest in *F. puma*, smallest in *F. bangsi*. In *F. concolor* the outer side of the crown (as seen from below) lies in two planes which meet and form a prominent obtuse angle opposite the interspace between the middle and posterior cusps (paracone and metacone). In most species the outer side of the tooth is concave at this point and the angle is carried much farther back (usually to the middle of the metacone) and is less prominent. The inner tubercle or protocone varies somewhat in specimens from the same region, and shows important differences when specimens from different localities are brought together. It is largest and most distinct in a young male *Felis puma* from Santiago, Chile (No. 36851 U. S. National Museum), while in specimens of *F. puma pearsoni* from the coast region of Patagonia it is nearly obsolete, the inner side of the front part of the tooth sloping down to the inner root very gradually (as in No. 20918, U. S. National Museum). In *F. hippolestes* it is large and prominent; in *aztecus* it is moderately developed: in *olympus* it is still smaller [in some specimens nearly obsolete], and in *concolor* from Brazil, *bangsi* from the northern Andes and Costa Rica, and *coryi* from Florida, it is only slightly developed.

Most of the Cougars present two color phases, independent of season. One of these is usually redder than the other. Thus at any time of year the animal of the Puget Sound region (*F. olympus*) may be 'red' or 'brown'—both of these terms, it must

be understood, giving an exaggerated idea of the real color and of the difference between the two. On Vancouver Island, according to John Fannin, Curator of the Provincial Museum at Victoria, the brown pelage is the common one; the red pelage rather rare. On the mainland the red is more common. In the case of the Rocky Mountain species (*hippolestes*), according to Roosevelt, the colors designated as 'red' and 'blue' are equally divided, 6 of each being recorded among the twelve animals killed by him in midwinter in Colorado.

A curious semi-pathological condition is common in skulls of Pumas from widely separated regions, namely, a tendency to cleft palate, consisting in a complete perforation of the palatine bones on or near the middle of the roof of the mouth. This perforation is usually bifurcate anteriorly and often measures 10 mm. or more in length. It is present in 6 out of the 12 skulls of the Roosevelt series from Colorado, in 5 out of 10 skulls in the Biological Survey Collection from Mexico, and in odd skulls from Arizona, Florida, and Vancouver Island.

For the loan of material additional to that in the collection of the Biological Survey I am indebted to Dr. J. A. Allen, Curator of Mammals and Birds in the American Museum of Natural History, New York; Outram Bangs, Curator of Mammals, Museum of Comparative Zoölogy, Cambridge, Mass.; Gerritt S. Miller, Jr., Assistant Curator of Mammals, U. S. National Museum, and Dr. Edgar A. Mearns, U. S. A. I wish particularly to acknowledge the generosity of Outram Bangs, who has sent me for description two new forms obtained by his collector in tropical America. In addition to these the only specimens of the Florida Puma I have seen are those in the Bangs collection.

In searching the literature for names that have been given to members of the group, I have been greatly aided by my assistant, Wilfred H. Osgood.

The number of specimens available at the present time is too small, and the gaps in their distribution are too great, to admit of anything like a complete and satisfactory study of the group, or to permit the ranges of the several forms to be mapped. The species and subspecies I am led to recognize, with their type localities, are:

Felis couguar Kerr. Pennsylvania.

Felis coryi Bangs. Florida.

Felis hippelestes Merriam. Wind River Mountains, Wyoming.

Felis hippelestes olympus Merriam. Olympic Mountains, Wash.

Felis hippelestes aztecus nob. Colonia Garcia, Chihuahua, Mexico.

Felis bangsi nob. Colombia, South America.

Felis bangsi costaricensis nob. Chiriqui, Panama or Costa Rica (boundary in dispute).

Felis concolor Linn. Brazil.

Felis puma Molina. Chile.

Felis puma patagonica nob. Base of Andes (latitude $47^{\circ} 30' S.$). Patagonia.

Felis puma pearsoni Thomas. Coast of Santa Cruz, Patagonia.

FELIS COUGUAR Kerr. Adirondack Cougar; Panther.

Felis couguar KERR, Animal Kingdom, p. 151, 1792.

Felis pennsylvanica LINK, Beitrage zur Naturgesch., II, p. 90, 1795.

Felis concolor MERRIAM, Mammals of Adirondacks, pp. 29-39, 1882 (habits).

Felis ontariensis hippelestes MILLER, Bull. N. Y. State Museum, No. 38, vol. VIII, p. 124, 1900.

Type locality.—Pennsylvania.

Geographic distribution.—Adirondack Mountains, New York, Green Mountains, Vermont,¹ and until recently higher Alleghenies of Pennsylvania, Maryland, and West Virginia, where a few may still occur.

Characters.—Size medium, head (apparently) disproportionately small for size of body; color dull fulvous; skull smallest of the known species.

Color.—"Body and legs of a uniform fulvous or tawny hue . . . Ears light-colored within, blackish behind. Belly pale reddish or reddish white. Face sometimes with a uniform lighter tint than the general hue of the body."—DeKay.²

Cranial characters.—Skull smaller and less massive than in any other North American species; nasals broader and blunter posteriorly than in *hippelestes* and *aztecus*, but very much smaller and narrower

¹ Cougars are exceedingly rare in New England where, so far as now known, they are restricted to the Green Mountains of Vermont. Professor George H. Perkins, of Burlington, Vt., writes me that panthers were killed in that state in 1870, 1875, 1881, and 1894, and that hunters believe that a few still exist in the Green Mountains. He tells me further that the one killed in 1881 was shot in Barnard, Vt., and was a very large animal; it is now in the state collection at Montpelier. During the present fall (1891) according to a Brattleboro newspaper, two men, while hunting ruffed grouse in the town of Andover, suddenly came upon a panther into which they emptied several charges of shot, apparently without serious result.

² DeKay, Mammals of New York, p. 47, 1842.

than in *coryi* from Florida; bullæ smaller; basioccipital broader; teeth smaller and more slender, particularly the large upper premolars (carnassial and pm 2).

Remarks.—*Felis couguar* Kerr, from Pennsylvania, although not heretofore recognized, appears to be specifically distinct from its nearest allies. Unfortunately specimens are so exceedingly rare that I have not been able to obtain a skin for comparison with the other forms of the group, and have examined only two skulls. Both skulls are adult, and both are from the Adirondack Mountains in northeastern New York (one from the east side, Essex County: No. 3811, U. S. National Museum; the other from the west side, probably Hamilton County: No. 947, Merriam Collection). These skulls are not marked for sex, but as one is larger than the other, and as the upper carnassial teeth present the usual sexual differences in size, I assume that one is a male (3811), the other a female (947). If this assumption is correct, the male is considerably smaller than the male of any other known species, while the female is about the same size as adult females of *concolor* and *aztecus*. The skull appears to be smaller in proportion to the size of the body than in the case of any other species.

Cranial measurements.—Two skulls from the Adirondacks, assumed to be male and female (measurements of female in parentheses): basal length 158 (154); zygomatic breadth 135 (128); occipito-sphenoid length 59 (55.5); postpalatal length 83 (80); inter-orbital breadth 36 (36); length of upper carnassial on cingulum 22.5 (20.5).

FELIS CORYI Bangs. Florida Cougar.

Felis concolor floridana CORY, 'Hunting and Fishing in Florida,' pp. 109-110, 1896. (Name preoccupied.)

Felis coryi BANGS, Proc. Biol. Soc. Wash., xiii, pp. 15-17, Jan., 1899.

Type locality.—Florida.

Characters.—Size large; color of back deep intense ferruginous. Head large; legs and tail long; feet small (Bangs); skull large and rather massive, with enormous nasals.

*Color.*¹—Upperparts rich intense ferruginous on back (from top of head to tail), becoming dull fulvous on sides, and fading gradually to belly where the hairs are much longer and paler; inguinal region soiled buffy-whitish; chin and lips yellowish buffy, becoming fulvous on throat and breast; ears and spot at base of whiskers black, the ear-

¹The present description is based on a skin and 6 skulls from near Sebastian, Florida, kindly loaned me by Outram Bangs.

spot descending to skin of head at base of ear; tail dark brown with a darker streak along dorsal line, becoming black before reaching tip, which is black all round.

Cranial characters.—Skull large and rather massive; nasals very large, exceeding in length and breadth those of all other North American forms; sagittal crest long and high; bullæ medium or rather small; underjaw large and massive. Compared with *F. cougar* from northern New York the skull is very much larger and heavier (an ad. male having a basal length of 175 and a zygomatic breadth of 152 contrasted with 158 and 135 in an old male from the Adirondacks); the sagittal crest (obsolete in *cougar*) long and high and reaching forward to frontal shield; nasals much larger, acutely pointed posteriorly and with a strongly marked hump at juncture of upper and middle thirds; frontals more flattened; bullæ slightly larger; teeth of the same size or very slightly larger; underjaw more massive (especially posterior part of horizontal ramus) and more bellied below posterior part of tooth row.

Compared with *aztecus*, with which it agrees essentially in size, and which is decidedly its nearest relative, it may be distinguished by the following characters: skull as a whole less massive; nasals very much larger and longer, with a distinct angle or hump at junction of upper and middle thirds; posterior ends of nasals reaching back nearly 10 mm. beyond plane of posterior endings of maxillæ [in *aztecus* the nasals and maxillæ end on essentially the same plane]; sagittal crest higher; under jaw slightly more bellied below tooth row; coronoid process longer and curved more strongly backward; upper carnassial larger; middle upper premolar smaller (thinner and weaker); lower carnassial slightly larger; first lower premolar smaller and weaker.

Remarks.—The Florida Puma differs so markedly from its North American congeners that a glance at either the skin or the skull is sufficient to distinguish it, the intense rusty red of the back and the great size of the nasal bones being characters not shared by any other species.

Individual skulls vary surprisingly in zygomatic breadth, as shown in two adult males of nearly equal size from Sebastian, Florida, both in the Bangs collection. One of these has a zygomatic breadth of 152 mm., and is very broad interorbitally. The other has a zygomatic breadth of only 135 mm., and is correspondingly narrow interorbitally. The nasals are largest in the narrowest skull, but are very broad and large in both.

In color the Florida Puma comes nearest to the widely remote *F. bangsi costaricensis* of Central America, with which it nearly agrees in the red of the back; but the face, legs and feet are grayer (less fulvous), and the tail is very different, being dark brown with a blackish stripe along the median line above; in *bangsi* the upper side of the tail is uniform dark reddish fulvous without trace of a dorsal stripe.

Measurements.—An adult male [tail and feet measured from dry skin by O. Bangs]: total length 2057; tail vertebræ 760; hind foot 280. An adult female: total length 1918; tail vertebræ 670; hind foot 271.

Cranial measurements.—Largest of 2 males, and largest of 2 females (females in parentheses) from Sebastian, Florida: Basal length 175 (158); occipito-nasal length 193 (174); zygomatic breadth 152 (123); occipito-sphenoid length 66 (59); postpalatal length 92.5 (82.5); interorbital breadth 44 (39); length of upper carnassial on cingulum 23.9 (22.8).

FELIS HIPPOLESTES Merriam. Rocky Mountain Cougar;
Mountain Lion.

Felis hipolestes Merriam, Proc. Biol. Soc. Washington, Vol. XI, p. 219, July, 1897.

Type locality.—Wind River Mountains, Wyoming.

Characters.—Size largest of the known members of the group; color dull fulvous; skull large and massive with highly developed sagittal crest.

Color.—Upperparts and sides dull pale fulvous brown, darkest on middle of back and tail; tip of tail black; face from nose to eyes grayish brown; a pale patch over each eye; back of ears blackish; chin, lips (except dark patch at base of whiskers), throat, breast, inner side of forelegs, inguinal region, and hinder part of belly soiled white; under side of tail grayish white.

Cranial characters.—Skull largest of the known species; heavy and massive; frontal region elevated but less elevated than in males of *olympus*; sagittal crest highly developed and arched; interorbital region broad [interorbital breadth in adult males about 48–50]; under jaw long, large and massive, somewhat swollen under premolars. Teeth large and powerful, the upper carnassial and 2d premolar much heavier and broader than in *aztecus*. Skulls of female *hipolestes* from the Rocky Mountain region are sometimes difficult to distinguish from males of *aztecus* from Chihuahua.

Remarks.—Skulls of *Felis hippolestes* are not only larger and more massive than those of other members of the group (save *olympus*) but differ in certain cranial and dental characters. A striking character is the enormous development of the sagittal crest, which in old males is considerably more than half an inch (13 mm. +) in height and strongly arched. In the females it is also well marked though by no means so high. The breadth between the orbits is much greater than in any of the other known forms except *olympus*, which agrees with it in this respect. In adult males of *hippolestes* the interorbital breadth varies from 47 to 50 mm; in adult females from 38 to 41 mm. In *Felis aztecus* from Mexico, Texas, southern Arizona, and southern California, the interorbital region is very much narrower, measuring in adult males from 38 to 41 mm. and in adult females from 34 to 36 mm. Similarly, the breadth across the postorbital processes, though more variable, is much greater in *hippolestes*, varying from 80 to 84 in adult males and from 71 to 76 in adult females. In males of *aztecus* this breadth varies from 68 to 75; in females 65 to 69. The braincase on the other hand is as broad in *aztecus* as in *hippolestes*.

The upper carnassial and the large premolar in front of it are much heavier and broader in *hippolestes* than in *aztecus*, while the length of the crowns is about the same in both. The lower molariform teeth are larger throughout in *hippolestes*, particularly the lower carnassial, which is conspicuously larger and more massive than in *aztecus*.

REMARKS ON THE ROOSEVELT SERIES OF SKULLS FROM COLORADO.

The 12 Cougars or Mountain Lions killed by Mr. Roosevelt near Meeker, Colorado, in January and February 1901, with their accompanying data as to size, weight, color, and time of breeding, form the most important series thus far recorded and their skulls afford an exceptional opportunity for ascertaining the constancy or inconstancy of particular cranial characters and proportions. The series comprises 3 adult males and 9 females of various ages. All were very fat and had been feeding on deer. The males are much larger than the females and have much larger teeth. One male is a giant, and has the largest skull of any Puma I have seen, surpassing even the type specimen of *Felis hippolestes* from the Wind River Mountains of Wyoming. In the flesh this animal measured 8 feet in total length from nose to tip of tail, and weighed 227 pounds. Among the females was a young of the preceding year, which had not yet shed its milk teeth, and which was still following its mother. The full data for these specimens, as furnished me by Mr. Roosevelt, are as follows:

No.	Sex.	Length. ¹		Weight lbs.	Color.	Date.	Remarks.
		Ft.	In.				
1	♂	8		227	red	Feb. 14, 1901	Contained 3 foetal young; would have been born in month or 6 weeks.
2	♂	7	8	164	blue	Jan. 27, 1901	
3	♂	7	6	160	red	Feb. 13, 1901	
4	♀	7		133	blue	Feb. 8, 1901	
5	♀	6	9	124	red	Feb. 5, 1901	Contained 3 foetal young; would have been born in a few days.
6	♀	6	7	120	blue	Jan. 31, 1901	
7	♀	6	7	118	blue	Jan. 15, 1901	Mother of 3 kittens, still blind, which were only three or four days old.
8	♀	6	9	108	red	Jan. 18, 1901	Milk in teats; accompanied by No. 12 [and undoubtedly its mother].
9	♀	6	5	105	blue	Feb. 12, 1901	
10	♀	6	4	102	red	Jan. 28, 1901	Mating with No. 2.
11	♀	6		80	blue	Jan. 14, 1901	With No. 9 [and undoubtedly its last year's kitten].
12	♀ yg.	4	11½	51	red	Feb. 12, 1901	

CRANIAL MEASUREMENTS OF THE ROOSEVELT SERIES OF
PUMAS FROM COLORADO.

Museum No.	Original No.	Basal length.	Basilar length of Hensel.	Zygomatic breadth.	Occipito-sphenoid length.	Post-palatal length.	Foramen magnum to plane of back of last pre-molar.	Interorbital breadth.	Occipito-nasal length.	Depth of skull (height of frontals above presphenoid.)	Under jaw. Symphysis to condyle.	Upper carnassial.
108681 ♂ old.	1	196	190	163	67	102	122	47	207	68	159	23
108682 ♂ ad.	2	184	178	148	68	96	112.5	46	191	65	143	24
108683 ♂ "	3										148	25
108684 ♀ "	4	172	167	134	62	91	105.5	38.5	183	58	136	20.2
108685 ♀ "	5	166	161	132	60	86	101.5	38	176	57	130.5	21.8
108686 ♀ "	6	170	165	138	60	88.5	102.5	41	172	58	134	22.5
108687 ♀ ygad.	7	163	158	135	57	85	100	38	173	57	129	22
108688 ♀ old.	8	159.5	155	130	56	83	95	37.5	167	57	126	22
108689 ♀ "	9	16	159	134	56	83.5	99	40	174	57	129	22
108690 ♀ "	10	1	158	133	56	85	98	40	174	58	129	21.5
108691 ♀ ad.	11	1	152.5	130	55.5	82	95	37	167	56	126	21
108692 ♀ juv.	12	129.5	125	105	47	64.5		31	134	47	101	milk tooth

SEXUAL VARIATION.

The skull.—The above measurements show that the sexual difference in size is greater than is usually recognized, the basal length of the largest male (196 mm.) exceeding that of the largest female (172 mm.) by 24 mm. (about an inch). In the oldest male the ratio of

¹ Length in straight line, between uprights, from nose to tip of tail.

zygomatic breadth to basal length is 84 (essentially the same as in the type of the species, from the Wind River Mountains, Wyoming); in the two oldest females it is about 81.5. The mean interorbital breadth in the males is 46.5; in the females 38.7. The sexual differences are well shown in the following table:

TABLE OF AVERAGE OR MEAN CRANIAL MEASUREMENTS.

	Basal length.	Basilar length of Hensel.	Zygomatic breadth.	Occipito-sphenoid length.	Post-palatal length.	Foramen magnum to plane of back of last pre-molar.	Interorbital breadth.	Occipito-nasal length.	Depth of skull (height of frontals above pre-sphenoid.	Under jaw Symphysis to condyle.	Upper carnassial.
Mean of males.....	190	184	155.5	67.5	99	117.2	46.5	199	65.5	150	24
Mean of females...	160.4	155.6	130.1	56.6	83.1	99.5	37.8	168.5	56.1	126.7	21.6

The teeth.—The teeth which show sexual differences to best advantage are the canines and carnassials. The diameter of the upper canine (measured on the cingulum) varies in the males from 14 to 15 mm.; in the females from 11½ to 12½. The length of crown of the upper carnassial varies in the males from 23 to 25 mm. (mean 24); in the females from 20.2 to 22.5 (mean 21.6).

INDIVIDUAL VARIATION.

The skull.—Individual variation in this series is less than was expected. The differences in size of the two perfect male skulls (amounting to 12 mm. in basal length and 15 mm. in zygomatic breadth) appear to be attributable to age, the smaller one being a young-adult with practically unworn teeth; the other a very old male with much worn teeth. In the females, individual variation in size is more marked. The largest and the smallest females are both young-adults with only slightly worn teeth; one has a basal length of 157 mm.; the other of 172 mm.—a difference of 15 mm.

The parts of the skull presenting the largest amount of individual variation are the nasal bones, the breadth of frontal across postorbital processes, the breadth of postorbital constriction, and the audital bullæ. The nasal bones in the two perfect males measure respectively: length 58 and 53 mm.; breadth between tops of premaxillæ 30 and 29; breadth between maxillæ posteriorly 20 and 16. In 4 of the 8 females the nasals are surprisingly uniform, the length falling between 45 and 46 mm.; breadth between points of premaxillæ 24 to 26; breadth

between maxillæ posteriorly 15–17. In the two oldest females the length of nasals is 44 and 41 mm. The breadth across the postorbital processes in the two males is 84 and 81—the difference apparently due to age. In the females it varies from 67 to 75 mm., and the skull in which it is only 67 is young and the frontals have not attained the full adult form. In the others it varies from 70 to 75.

The postorbital constriction in 6 of the 8 females falls between 40 and 43 mm. In the other two skulls, both of which are very old, this part of the skull is broader, measuring 44.5 in one and 45.5 in the other. In many Carnivores (and other mammals as well) the breadth of the postorbital constriction decreases with age. In the Pumas it appears to increase with age. I am not perfectly sure however that the increased breadth in the two old skulls may not be due to the presence of parasites in the frontal sinuses, as is often the case in the Mustelidæ.

The bullæ are surprisingly constant in size and form throughout the series except in one skull, in which they are greatly inflated. This is the skull of a very old female and is the same in which the postorbital inflation is greatest, hence there seems to be ground for the suspicion that in both cases the increased size may be the result of disease. In this skull the breadth of the basioccipital is materially decreased by the great size of the bullæ, measuring 4 mm. less than in a skull of approximately equal age with normal bullæ.

A curious feature connected with these skulls is the tendency to cleft palate. One of the males and two of the females have each a large perforation in the middle of the roof of the mouth. This perforation or vacuity extends completely through the palatine bones on the median line, measures 13 mm. in length in two and 10 in the third, and is bifurcate anteriorly, the anterior ends notching the posterior margin of the palatal floor of the maxillary bones on each side of the vomer. Three other females have a complete perforation a little behind the maxillo-palatine suture, but of considerably smaller size. Hence six out of the twelve specimens have the palate completely perforated, and in four of these the perforation is of considerable size and bifurcate anteriorly.

The teeth.—Individual variation in the teeth in the 3 male skulls of the series is small (only 1 mm. in each direction from the mean) and mainly attributable to the usual wear with age. In the female it is somewhat greater, the extremes in length of crown of upper carnassial falling 1.4 mm. below the mean, and reaching 0.9 mm. above the mean. Part of this also may be attributed to wear.

FELIS HIPPOLESTES OLYMPUS Merriam. Pacific
Coast Cougar.

? *Felis oregonensis* RAFINESQUE, Atlantic Journal, Vol. 1, No. 2, p. 62, 1832.
Felis hipolestes olympus MERRIAM, Proc. Biol. Soc. Washington, Vol. XI,
p. 220, July, 1897. [The type specimen proves to be a ♀, not a ♂, as
marked by collector.]

Felis oregonensis STONE, Science, NS., Vol. IX, pp. 34-35, Jan. 6, 1889.

Type locality.—Olympic Mountains, State of Washington.

Geographic distribution.—Coast region of British Columbia,
Washington, Oregon and California.

Characters.—Similar to *hipolestes*, but color much darker; whitish
areas of underparts more restricted and less white; tail decidedly
darker (dark all round, not grayish white below), the black tip
longer; nose and face very much darker.

Cranial characters.—Skull large and massive; frontals enor-
mously swollen, elevated, narrow, and highly arched transversely,
with tendency to the development (especially in young-adults) of a
median longitudinal sulcus; frontals much swollen over postorbital
processes and anterior part of orbits. Skull similar in size, massive-
ness, and general characters to that of *hipolestes*, from which it
differs in having the facial and frontal regions more abruptly elevated;
the frontals narrower, more swollen, and more highly arched trans-
versely, with usually a median longitudinal depression or groove;
nasals with more decided angle or 'hump' at junction of upper and
middle thirds (upper third horizontal, then bent abruptly downward);
basal part of skull longer, giving greater length to the occipito-sphenoid
and postpalatal measurements; pm. $\frac{1}{1}$ slightly longer; pm. $\frac{2}{2}$ thinner
(especially posteriorly); pm. $\frac{2}{2}$ thinner.

Measurements.—Type specimen, ♀ ad. (from well made dry skin):
total length 2095; tail 775; hind foot 260.

Cranial measurements.—♂ yg. ad. from Vancouver Id., B. C., and
♀ ad. (type specimen) from Olympic Mts., Washington (measure-
ments of ♀ in parentheses): Basal length 192 (161.5); zygomatic
breadth 153.5 (127); occipito-sphenoid length 70? (60); postpalatal
length 120? (97); interorbital breadth 45.5 (39); upper carnassial
23.5 (22.5).

Respecting the technical name of the Pacific Coast Cougar, a few
words may not be out of place: Witmer Stone, in *Science* of Jan.
6, 1899 (Vol. IX, pp. 34-35), announced that he had recently un-
earthed an old name, given by Rafinesque in the *Atlantic Journal* in
the summer of 1832, to a Cougar from western America. This name
Mr. Stone adopts for the northwest coast animal in place of the name

olympus given by me in 1897. He quotes Rafinesque's original description as follows: "1. Var. *Oregonensis*. Dark brown, nearly black on the back, belly white; body 6 feet long, 3 high, tail 2 or 3 feet long. A large and ferocious animal of the mountains. Is it not a peculiar species? *Felix oregonensis*."

Rafinesque knew nothing of the animal he attempted to describe. He had never seen a specimen, nor had he ever been within two thousand miles of the northwest coast country. Furthermore, his brief description is grossly incorrect, as the animal is not "nearly black on the back," and its belly is not white. In this, as in numerous other cases, his information was obtained from travelers at second or third hand. Who now-a-days would think of proposing or accepting a modern name based on hearsay accounts of travelers and not even accompanied by the mention of a definite locality?

In cases where the description of an old author leaves no room for doubt as to the species meant, or where a modern author adopts or redefines an old name, as I have sometimes done myself, its status is of course fixed and not subject to change. But the deliberate displacement of a name based on a definite type specimen from a stated locality and accompanied by an adequate description, in order to replace it by an older name of exceedingly dubious applicability and unaccompanied by either definite locality or adequate description, involves, in my judgment, a fallacious interpretation of our principles of nomenclature.

In the case in point, Mr. Stone candidly admits that "no definite locality is given under the description of *F. oregonensis*," and it is only by implication that the name can be attributed to the Oregon country. In this connection it should be borne in mind that Oregon in those days embraced not only the present states of Oregon and Washington, but also Idaho, the western part of Montana, and much of British Columbia. In the same paper Rafinesque names another species, *Felis macroura*, said to be not larger than a cat, "with tail as long as the body, which is from one to two feet long only." Even Mr. Stone admits that "the source of this information is unreliable and the probability is that no such animal existed"!

In the introductory paragraph of his paper Rafinesque says (also quoted by Mr. Stone): "In addition to the article on our Couguars, page 19 [in which 5 varieties are characterized from Carolina, Green Mountains, Kentucky, New Hampshire, and Pennsylvania], I have to state that several other varieties of tygers are found in the western wilds of the Oregon mountains, or east and west of them, which deserve to be noticed. I find in my notes that two other varieties of

Cougar have been seen there, and east of the mountains." Hence it appears that Rafinesque, as long ago as 1832, recognized at least 8 varieties of cougar as inhabiting the United States from Carolina and Kentucky northward. I find no evidence to show that he ever saw a specimen of any of these, his descriptions (if such they may be called) being based wholly on the accounts of hunters and travelers, assisted by his fertile imagination.

FELIS HIPPOLESTES AZTECUS subsp. nov.

Mexican Cougar.

Type from Colonia Garcia, Chihuahua, Mexico. No. 99658 ♂ ad. U. S. National Museum, Biological Survey Coll. Oct. 17, 1899, H. A. Cluff. Orig. No. 2401.

Characters.—Animal large and powerful but decidedly smaller than *hippolestes*; general color dull fulvous as in *hippolestes*, but tail darker, browner, with longer black tip and no white underneath (much as in *olympus*); ears almost wholly black.

Cranial characters.—Skull large and massive, similar in general to that of *hippolestes* but *decidedly shorter*; braincase of same size; frontals narrower interorbitally (the interorbital breadth in adult males averaging about 40 or less instead of 48 or more); sagittal crest less highly developed; upper carnassial teeth lighter and thinner; lower teeth (particularly the carnassial) smaller throughout.

Remarks.—Compared with *coryi* from Florida the whole animal is very much paler and grayer; top of head and upperparts generally dull grayish fulvous instead of intense ferruginous; underparts whiter; black of ear not extending below actual base of ear; color of chin and lips very different, being soiled white instead of intense yellowish buff.

A skin in the collection of the Biological Survey from Fort Bowie, Arizona, is paler and grayer (less fulvous) than the skins from Chihuahua, and has the back much more conspicuously mixed with black hairs. The same is true in even greater degree of a skin in the National Museum from Eagle Pass, Texas.

The skull of *aztecus* is considerably smaller than that of *hippolestes* and may be characterized briefly as *short*, heavy, and massive, with *narrow interorbital region*, elevated arched frontals, and well developed sagittal crest—though never so high as in *hippolestes*. Three skulls of adult males from a single locality, Colonia Garcia, Chihuahua, exhibit a most amazing variation in the size of the audital bullæ, a degree of variation which in most mammals would characterize perfectly distinct species. In one of these skulls (No. 99660) the bullæ

are small, low, and narrow and not of the same size. In another (No. 99659) they are enormously swollen and inflated posteriorly, and rather sharply pointed anteriorly. It is probable that the medium condition shown in No. 99658 is the normal, that No. 99659 is exceptionally inflated, and that No. 99660 has the bullæ imperfectly developed. This is the more probable because of the difference in the bullæ on the two sides in No. 99660, the left being considerably smaller and less perfect than the right.

Measurements.—Type (♂ ad.): total length 2268; tail vertebræ 731; hind foot (from dry skin) 270; height at shoulder 731. Average of 3 males from type locality: total length 2074; tail vertebræ 772; hind foot (from dry skin) 260; height at shoulder 714. An adult female from type locality: total length 1814; tail vertebræ 630; hind foot (from dry skin) 230; height at shoulder 630.

Cranial measurements.—Largest of 3 males (the type), and largest of 3 females (female in parentheses) from Colonia Garcia, Chihuahua, Mexico: basal length 171.5 (149); zygomatic breadth 142 (121); occipito-sphenoid length 60 (53); postpalatal length 91 (76.5); interorbital breadth 41 (36.5); upper carnassial 22 (20).

FELIS CONCOLOR Linn. Brazilian Puma.

Felis concolor LINNÆUS, Syst. Nat., ed. XII, Addendum to Vol. III, Mantissa Plantarum, p. 522. 1771.

Type locality.—Brazil (probably southeastern Brazil).

Characters.—Size medium; color apparently yellowish fulvous; cranial and dental characters distinctive.

Color.—The original diagnosis by Linnæus is merely “cauda elongata, corpore immaculato fulvo.” It is based mainly on Brisson, who states that the color is reddish yellow. Burmeister (whose description is apparently of a specimen from Neu-Freiburg, southeastern Brazil) gives the color as rather pale reddish yellowish gray; with throat, chest and inner sides of arms and thighs pure white; belly yellow; outside of ears blackish brown with a yellowish spot; tip of tail blackish brown. (Thiere Brasiliens, Säugthiere, pp. 88–89, 1854).

*Cranial characters.*¹—Skull of medium size, thin and light compared with the North American and Chilean species; face and frontal

¹ The present description is based wholly on two skulls from Brazil in the collection of the Biological Survey: an adult male, No. 100118 from Piracicaba, São Paulo; and an adult female without particular locality. For both I am indebted to the courtesy of Prof. Herman von Ihering. The male when young had suffered some injury to the top of the head, in the posterior frontal region, as if he had been dealt a blow with a machete. The resulting deformity may have prevented the development of the sagittal crest.

region elevated and set forward; ascending arms of maxillæ much more nearly vertical than in *F. puma*; interorbital region rather broad; sagittal crest absent or only slightly developed; nasals short, broad and blunt posteriorly; no pit in frontal over apex of nasals [present in all other species]; suture between basi-sphenoid and presphenoid closed in adults; presphenoid very broadly exposed, its base broader than in any other species; pterygoid wings correspondingly reduced; *under jaw small, light and straight*, not enlarged or swollen beneath the teeth; *symphysis short*, truncate, and more anterior than in the other species; bullæ rather large; ratio of zygomatic breadth to basal length in an ad. ♂ 80; teeth rather large; upper carnassial distinctive, having a well-marked salient angle on outer side between middle (paracone) and posterior (metacone) cusps, which is not present in any other species.

Compared with *F. bangsi* from Colombia and Peru, the skull of *concolor* is larger; frontals decidedly more elevated; bullæ larger; teeth, particularly carnassial and middle upper premolar, larger; upper carnassial with a salient angle on outer side as already described. Compared with *F. puma* from Chile the skull as a whole is lighter, frontals more elevated; 2d premolars, above and below, very much smaller; crown of lower carnassial much shorter and more swollen. (For more detailed comparison see under *F. puma*.)

Compared with the North American members of the group, *Felis concolor* from Brazil differs markedly in cranial characters. The skull as a whole is lighter, the braincase thinner and more smoothly rounded, and in the specimens at hand devoid of sagittal crest. The nasal bones are more bluntly truncate posteriorly than in any skulls I have seen from Mexico or the United States, and the pit at point of junction with the frontal bone is absent. The presphenoid, viewed from below, is much more broadly exposed, and the pterygoid wings are correspondingly shortened. The under jaw is straighter and lighter than in any of the North American forms and lacks the usual swelling beneath the teeth; the lower border of the ramus is slender, narrow, and straight; the symphysis is shorter, more anterior, and more truncate. In an adult male from São Paulo, Brazil (No. 100118) the bullæ are enormously inflated and the inflation is much broader than in any others I have seen. The only approach to it is in a specimen from Colonia Garcia, Chihuahua, Mexico (No. 99659), in which the posterior part of the bulla is greatly swollen, but the anterior part is abruptly narrowed. The skull in question from Colonia Garcia is abnormal in this respect, the bullæ being strikingly larger than in other specimens from the same

locality. The large amount of individual variation in the bullæ leads me to distrust their reliability as affording characters. Their great size in the São Paulo specimen may be abnormal.

Cranial measurements.—An adult ♂ (No. 100118 U. S. N. M.) from São Paulo, Brazil, and a yg-ad. ♀ from Brazil (exact locality unknown—the ♀ in parentheses): Basal length 171 (141); zygomatic breadth 139 (112); postpalatal length 88.5 (72); interorbital breadth 41 (31); upper carnassial 23.5 (22).

FELIS BANGSI sp. nov. North Andean Puma.

Type from Dibulla, Colombia, South America. No. 8413 ♂ ad. Bangs Collection. October 8, 1899. W. W. Brown, Jr.

Characters.—Size medium; pelage (in type specimen) short and rather coarse; color rusty or reddish fulvous; skull rather light; teeth smallest and slenderest of the known species.

Color.—Upperparts from head to tail ferruginous, not noticeably mixed with black hairs and rather narrowly confined to top of back, shading to dull fulvous on sides; the fulvous becoming still paler on belly, throat, legs, and feet; inguinal and pectoral regions whitish; chin and lips buffy white, the upper lip posteriorly suffused with pale dull fulvous; ears blackish except at extreme base; tail above ferruginous, becoming dark rusty brown, but without trace of dark median stripe; below grayish brown, the dark brown underfur showing through; tip black, and in the type specimen indistinctly annulated, there being an incomplete blackish ring above the tip, preceded and followed, on the sides, by grayish fulvous intervals.

Cranial characters.—Skull of medium size and rather light; sagittal crest in male, high where it crosses occipital sulcus, and continuing in a low ridge to frontals; frontals not elevated and rather flattened; nasals (in type specimen) moderately broad and obliquely truncate posteriorly; females without trace of sagittal crest except across occipital sulcus; bullæ and basisphenoid normal. Teeth smaller than in any other known species; canines very slender; upper carnassial in adult male measuring only 22 mm. Sexual differences in size unusually marked, both in skull and teeth. Skull similar in general to that of *concolor* from Brazil, from which it differs in flatter and lower frontals, presence of distinct sagittal crest (in adult male), smaller bullæ; narrower exposed base of presphenoid; persistence of sphenoid suture; much more slender canines, smaller and narrower premolars and carnassials, and absence of outer angle on upper carnassial (the place of this angle being concave). Compared with *F.*

puma from Chile, the skull is smaller (particularly *shorter*) and much less massive: anterior base of coronoid process much less broadly expanded; teeth strikingly smaller throughout—the difference much more marked than in the comparison with *concolor*.

Remarks.—Mr. Bangs has sent me two skins with skulls from Colombia. One (the type) is an adult male collected October 8 at Dibulla; the other an adult female collected February 15 in the Santa Marta Mountains. The Santa Marta specimen has narrow ‘pinched in’ nasals (the posterior two-thirds abruptly narrower than the anterior third), and differs so strikingly in pelage and markings as to suggest the possibility that it may be subspecifically distinct—a high mountain form perhaps. The ears appear to be longer. The pelage is long and full and has a very different appearance from that of the short smooth coat of the Dibulla specimen. The rusty dorsal area (from head to tail) is broader and darkened by profuse admixture of black hairs; dull fulvous of sides also strongly mixed with black hairs; ferruginous of tail continues to black tip; tip not annulated; whitish of underparts much whiter and much more extensive, completely covering inner sides of legs and in foreleg reaching continuously to pads on underside of foot; outer sides of forelegs and feet grayish fulvous indistinctly vermiculated with brownish.

Two skulls from Peru, in the American Museum of Natural History, appear to be young-adult males of this species.

Measurements.—(Female ad. no. 8147 Bangs Coll., from Santa Marta, Colombia, measured in flesh): Total length 1600 mm.; tail vertebrae 610; hind foot 225; ear 80.

Cranial measurements.—An ad. ♂ (the type); and an ad. ♀ (in parentheses) from Santa Marta Mountains, Colombia, both in the Bangs Coll. Basal length 162 (141); occipito-nasal length 173 (151); zygomatic breadth 128 (115); occipito-sphenoid length 60 (50); postpalatal length 85 (72.5); interorbital breadth 37 (31.5); upper carnassial 22 (20).

FELIS BANGSI COSTARICENSIS subsp. nov.

Central American Puma. :

Type from Boquete, Chiriqui, Panama (or Costa Rica—the province of Chiriqui being claimed by both countries). No. 10118 ♀ ad. Bangs Coll. April 22, 1901. W. W. Brown, Jr.

Characters.—Similar to *F. bangsi* but color very much darker and redder, particularly on the belly which is red like the sides, with only an indistinct narrow whitish line down the middle, barely connecting the whitish pectoral and inguinal areas; fur between foot pads black.

Measurements.—(Type specimen, ♀, measured in flesh) Total length 1680 mm.; tail vertebrae 680; hind foot 220; ear 75.

Remarks.—The U. S. National Museum contains two skins from Costa Rica, presented by the World's Fair Costa Rica Commission in 1893. In both of these the whitish pectoral and inguinal regions are suffused with dirty yellowish brown, which may be due to immersion in pickle. The skull of one of these (the female, No. 61193 U. S. National Museum) agrees essentially with the skull of the type specimen except that the nasals are longer, and with the female *bangsi* from the Santa Marta Mountains, except that the nasals are not narrowed as in that specimen. The skull labeled as belonging to the skin of the male (No. 61194) has the middle upper premolar and carnassial greatly swollen and presents other characters which lead to the suspicion that it really has nothing to do with this skin, but probably came from some other region. This view is the more probable since the skull of a fully adult male from Pacuare, Costa Rica (No. 15967 U. S. Nat. Museum) agrees closely with the type specimen of *bangsi* (a male from Dibulla, Colombia) and, allowing for normal sexual differences, with the female from Costa Rica. In this connection it may be stated that the lower carnassials in females of *bangsi* and *costaricensis* are surprisingly small.

FELIS PUMA Molina. Andean Puma.

Felis puma MOLINA, Saggio sulla storia Naturale del Chili, pp. 295–297, 1782.

Type locality.—Chile.

Characters.—Size large; color gray or grayish instead of fulvous. According to Molina the animal has a mane. Skull and teeth large and massive.

Color.—Upperparts “ash-colored with a sprinkling of yellowish . . . underparts whitish.”—Molina. The skin of the head of a specimen from Santiago, Chile (No. $\frac{12751}{36851}$ ♂ young, U. S. Nat. Museum) has the nose and face brownish gray, becoming pale dull fulvous on top of head; upper eyelid, lips and chin yellowish white; ears grayish, mixed with black hairs at base and toward tip but without distinct dark spot; a small blackish streak on upper lip just below whiskers; occiput and back of neck dull grizzled grayish fulvous.

Cranial characters.—Skull and teeth large and massive; 2d premolar, above and below, much larger than in any other known species of the group; inner tubercle (protocone) of upper carnassial very large. The skull of a young male from Santiago, Chile (No. 36851 U. S. National Museum), contrasted with an adult male of *concolor* from

São Paulo, Brazil (No. 100118 U. S. National Museum, Biological Survey Coll.) presents the following differences: nasals more angular posteriorly (less bluntly truncate); bullæ smaller; basioccipital broader between bullæ; premaxillæ more swollen over canines (owing to larger size of these teeth); presphenoid much narrower posteriorly between wings of pterygoids; suture between presphenoid and basisphenoid not closed; under jaw more massive and more swollen under tooth row; basal half of anterior border of coronoid process much more broadly expanded transversely; upper incisors and canines much larger and heavier; middle upper premolar and lower premolars larger; body of upper carnassial thinner and lacking the external angle of *concolor* (the part occupied by the angle in *concolor* being concave); inner tubercle (protocone) very much larger than in any other Puma I have seen; posterior end of crown of middle upper premolar curved strongly outward; 2d lower premolar much broader posteriorly; and nearly twice as massive as in *concolor*; lower carnassial with anterior blade more flattened or 'dished' on outer side; upper molar twice as large as usual (crown 10 mm. in length).

Remarks.—The skull from Santiago, Chile (36851), on which the present description is based, is not full grown (evidently in second year), and the cranial characters are not fully developed. The dental characters, however, are shown to unusual advantage, the teeth being unworn. The most noteworthy tooth characters are the enormous size of the 2d upper and lower premolars and upper molar, and the large size of the inner tubercle (protocone) of the upper carnassial. The upper carnassial measures 24×12.8 mm. The skin of the head and neck of this specimen differs from the type of *F. puma patagonica* from east base of Andes, Patagonia, in having the face and head darker and browner (quite different from the clear gray of *patagonica*); neck decidedly more fulvous; ears without distinct markings.

FELIS PUMA PATAGONICA subsp. nov.

South Andean Puma.

Type from east base of Andes, Patagonia (lat. $47^{\circ} 30'$). No. 108693 [♂ yg-ad.] U. S. National Museum, Biological Survey Coll. 1899. J. B. Hatcher.

Characters.—Size large; color gray; black of ears nearly obsolete; skull and teeth large and massive; frontals low (depressed contrasted with *concolor* and the North American forms), giving the cranium an appearance of unusual length; tooth characters distinctive.

Color.—Upperparts ash gray, everywhere abundantly mixed with

black hairs, the median dorsal region from top of head to end of tail suffused with buffy; belly buffy gray, the hairs much longer than on the back; pectoral and inguinal regions soiled whitish; throat gray; chin and lips white, the posterior part of upper lip and cheeks suffused with buff; patch at base of whiskers gray (instead of black); rest of face gray, except a buffy streak above and below the eye; backs of ears gray, with apical third and a faint basal band dusky; feet buffy gray; tail pale buffy fulvous above, ash gray below, with only the extreme tip dusky.

Cranial characters.—Skull massive, elongate; facial and frontal regions low and narrow; interorbital region narrow; nasals rather broad posteriorly and obliquely truncate; sagittal crest low, continuous to frontal shield; bullæ rather large; postpalatal notch broad; the palatal margin nearly straight; presphenoid normal. Canines large (the upper ones 14.5 mm. in diameter); crowns of premolars and carnassials long; upper molar small (as usual in the group); inner cusp (protocone) of upper carnassial very small. Compared with the skull of *F. puma* from Santiago, Chile, the following tooth differences are conspicuous: crown 2d upper premolar larger and thinner; crown of upper carnassial longer, with inner tubercle greatly reduced; upper molar small (less than half the size of this tooth in *puma*); 2d lower premolar smaller (decidedly less swollen); lower carnassial decidedly larger.

Compared with an old male *concolor* from São Paulo, Brazil, the facial and frontal regions are very much lower; frontals flatter; bullæ smaller; presphenoid narrower; sphenoid suture distinct; postpalatal notch broader; sagittal crest present; under jaw more massive, the symphysis much longer; canines much larger; crown of second upper premolar much longer and narrower; crowns of upper and lower carnassials (particularly the lower) decidedly longer; crowns of lower premolars longer, the 2d much more swollen posteriorly.

Remarks.—Compared with the skin of a head of *F. puma* from Santiago, Chile, the color of the corresponding parts in *patagonica* is lighter and everywhere much grayer (less brownish and without fulvous cast); ears with distinct dark markings at base and tip; upper lip with only a trace of the dark mark below whiskers; lips and chin whiter; light band on under eyelid much broader and purer. Compared with subspecies *pearsoni* Thomas, the general color is much paler and grayer, the ear and face markings much more distinct, the tip of tail dusky.

Measurements.—(From dry skin.) Total length 2015; tail vertebrae 670.

Cranial measurements.—Type specimen (♀ yg-ad.) from base of Andes: Basal length 168; occipito-nasal length 177; zygomatic breadth 135; postpalatal length 86; interorbital breadth 36; upper carnassial 24.3.

FELIS PUMA PEARSONI (Thomas). Santa Cruz Coast Puma.

Felis concolor pearsoni THOMAS, Annals & Mag. Nat. Hist., 7th Ser., Vol. VIII., pp. 188-189, September, 1901.

Type locality.—Santa Cruz, Patagonia (about 70 miles from coast).

Characters.—Distinguished from *F. puma* "not only by its different general color, but also by its shorter tail, light colored ear-backs, and the absence of the dark markings round the digital pads."—Thomas.

Color.—"General colour nearest to Ridgway's 'clay-colour,' therefore exceedingly different from the nearly 'drab-grey' of *F. c. puma*. This colour is most vivid along the back, paler laterally on the sides, but there is nothing that can be called a distinct dorsal dark line. Under surface whitish fawn, the hairs sandy at their bases, whiter terminally. Face very much like back, darker markings practically obsolete; the usual lighter markings near the eye present but not conspicuous. Ears of normal length, their backs uniformly whitish fawn, without darker markings. Outer sides of limbs like back, inner side like belly; ends of fingers and toes whitish, without any darker markings round the pads. Tail proportionally very short, brownish clay-colour above, whitish below, the tip not or scarcely darker."

Cranial characters.—In describing this form Mr. Thomas had no skull. The U. S. National Museum and Biological Survey, however, have two skulls, evidently male and female, from the coast region of Santa Cruz, near the type locality of Mr. Thomas' skin. The male is from Coy Inlet (lat. 51° S., collected by Hatcher); the exact locality of the female is unknown. These skulls agree among themselves, and differ from *F. puma* from Chile and *F. puma patagonica* from the base of the Andes, in having the frontal region more elevated, the interorbital breadth greater, the nasals very much broader posteriorly and abruptly truncate instead of angular, and the anterior base of the coronoid process of under jaw much less broadly expanded.

Remarks.—From Thomas' description it appears that the coast animal (*pearsoni*) is very much *yellowier* than the animal from the Andes (*patagonica*), and that it lacks the dark ear patches and distinct face markings of *patagonica*. The tail appears to be short.

Measurements.—(Type specimen, "tanned and stretched, so that the measurements are merely approximate"). Head and body 1370 mm.; tail 530; ear 80.

Charles Anthony Schott.

1826-1901.

Charles Anthony Schott, astronomer, geodesist, magnetician, mathematician, meteorologist, was born August 7, 1826, in Mannheim, Germany, and died July 31, 1901, in Washington, D. C. Graduating C. E. from the Polytechnic School in Carlsruhe, in 1847, he came to the United States and entered the Coast Survey in 1848. The rest of his long, industrious and useful life was spent in that organization and almost exclusively in office work. For more than half a century he served in its computing division and for 45 years of that time he was its chief. The amount of work performed by this diligent, methodical and industrious scientist was enormous, and his influence upon the character and work of the Coast Survey probably exceeds that of any individual ever connected with the organization.

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